Surgical management of supraventricular tachycardia associated with congenital cardiac anomalies

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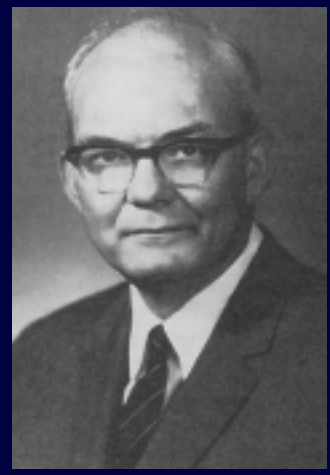
Background of arrythmia surgery

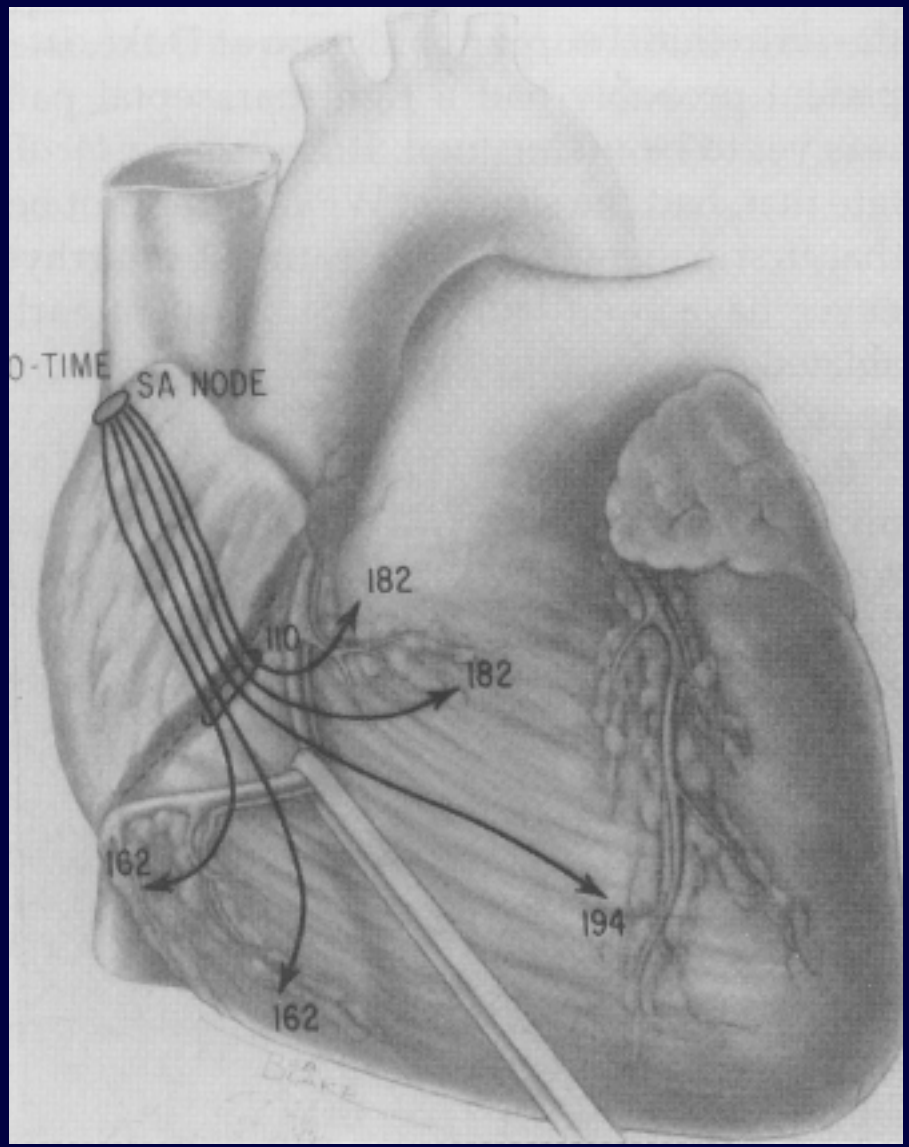
First stage

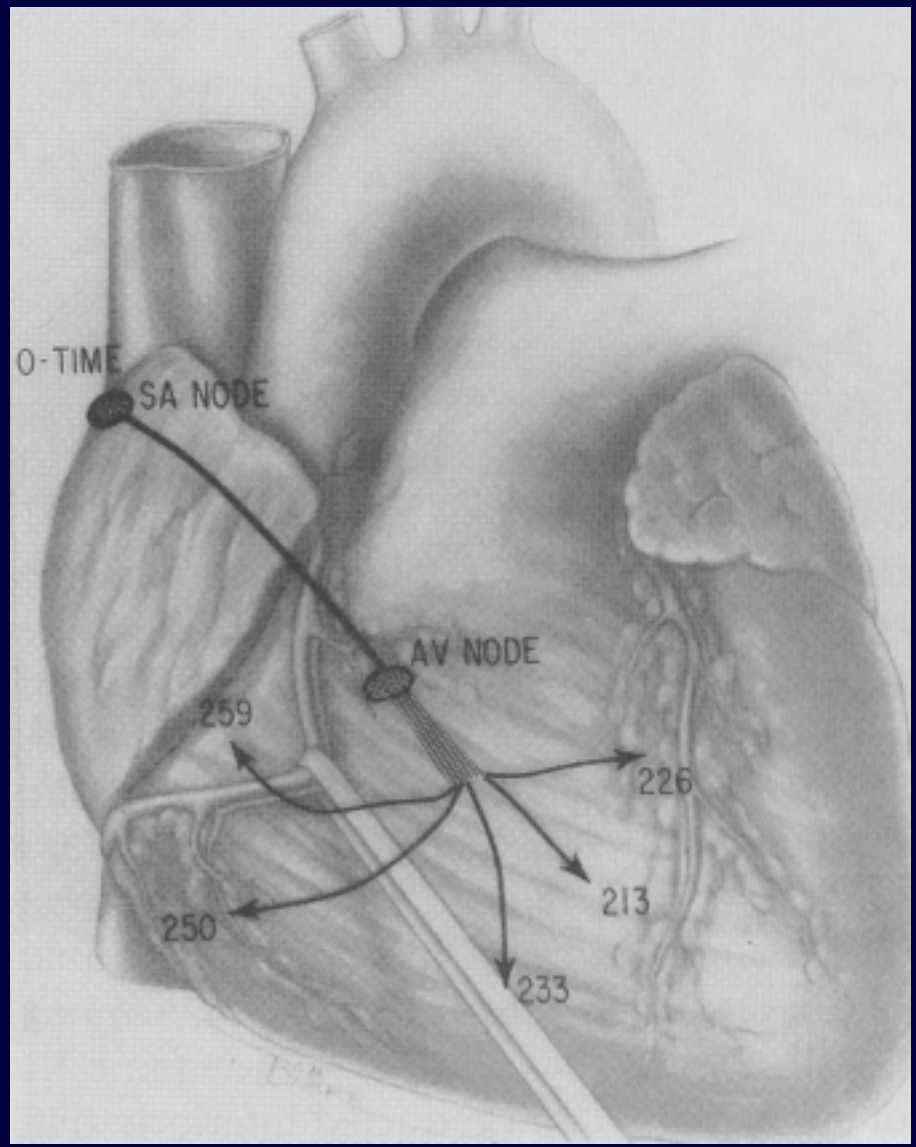
Dr will C. Sealy
Duke university



Successful Surgical Interruption of the Bundle of Kent in a Patient with Wolff-Parkinson-White Syndrome

By Frederick R. Cobb, M.D., Sarah D. Blumenschein, M.D., Will C. Sealy, M.D., John P. Boineau, M.D., Galen S. Wagner, M.D., and Andrew G. Wallace, M.D.


0-TIME
SA NODE
182
110
182
162
194
162


0-TIME
SA NODE
AV NODE
259
226
213
250
233

Second stage

Transcatheter radiofrequency (RF) ablation

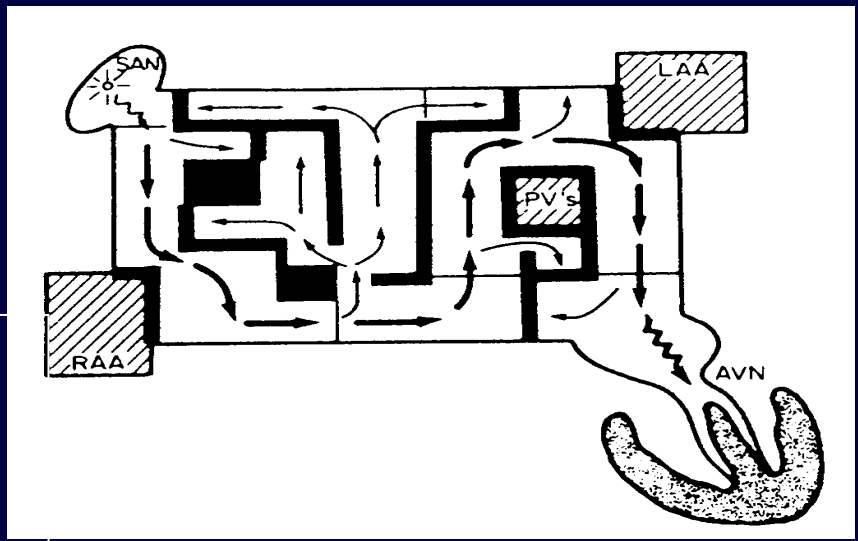
- map of offending arrhythmia
- deliver RF energy to precise intracardiac location
- success of catheter ablation technique for accessory connection-mediated tachycardia and AV nodal reentry tachycardia
- expansion to atrial ectopic foci, atrial flutter, atrial reentry tachycardia following repair of congenital heart disease

Development of Cox-Maze operations for atrial fibrillation (1991)

Restore a regular ventricular rhythm

Restore normal cardiac hemodynamics

Alleviate the patient's vulnerability to thromboembolism



Cryosurgical ablation of His bundle (1973)

LA isolation procedure (1980)

Catheter ablation of His Bundle (1985)

Corridor procedure (1985)

Third stage

- Patients with arrhythmia and coexisting acquired or congenital heart disease

  (Patients who could undergo concomitant reparative and arrythmia surgery)

- Patients who have failed catheter ablation and/or have a wide arrhythmogenic focus not suitable for ablation

Indications for surgical ablation

Accessory pathway mediated tachycardia (WPW syndrome)	Ebstein's anomaly Congenitally corrected TGA Complex congenital heart disease
Atrial reentry tachycardia	Fontan procedure with residual hemodynamic abnomalities Senning or Mustard repair undergoing baffle revision Tetralogy of Fallot undergoing revision Atrial septal defect for surgical closure
Atrioventricular nodal reentry tachycardia	Senning or Mustard repair undergoing surgery Complex congenital heart disease
Atrial fibrillation	Mitral valve surgery Fontan surgery

Accessory pathway mediated tachycardia : **Wolff- Parkinson-White syndrome**

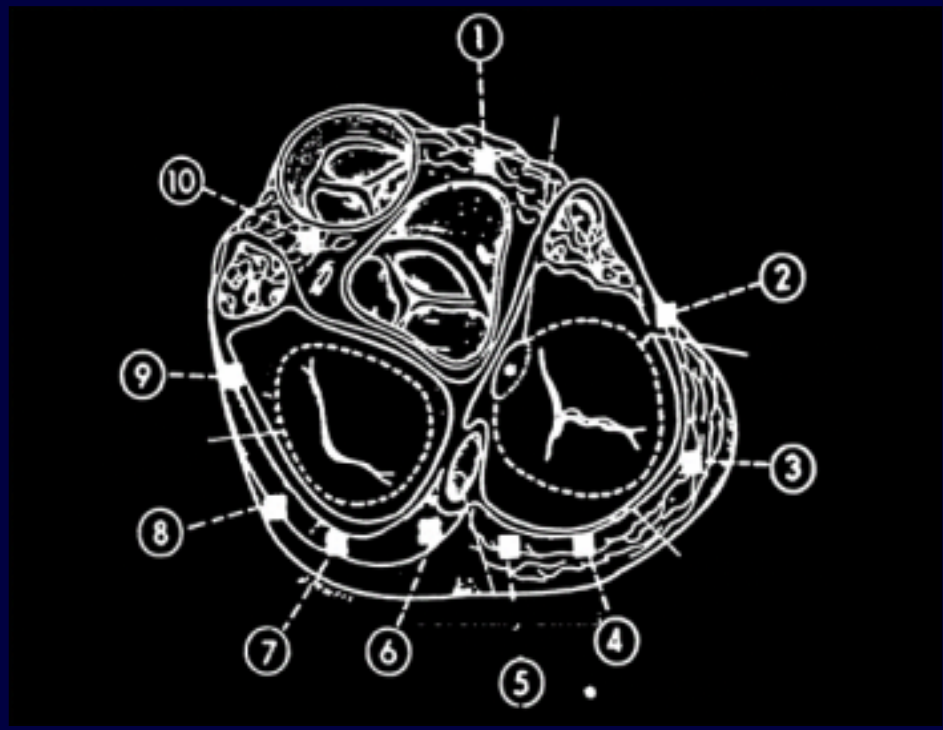
10 - 29 % in Ebstein's anomaly

Location

Left free-wall

Right free-wall

Septal



Transcatheter ablation

Acute success rate

- 89-99%
- **Highest left-sided pathways**
- ***Lower septal and right-sided pathways***

Posteroseptal pathways ;

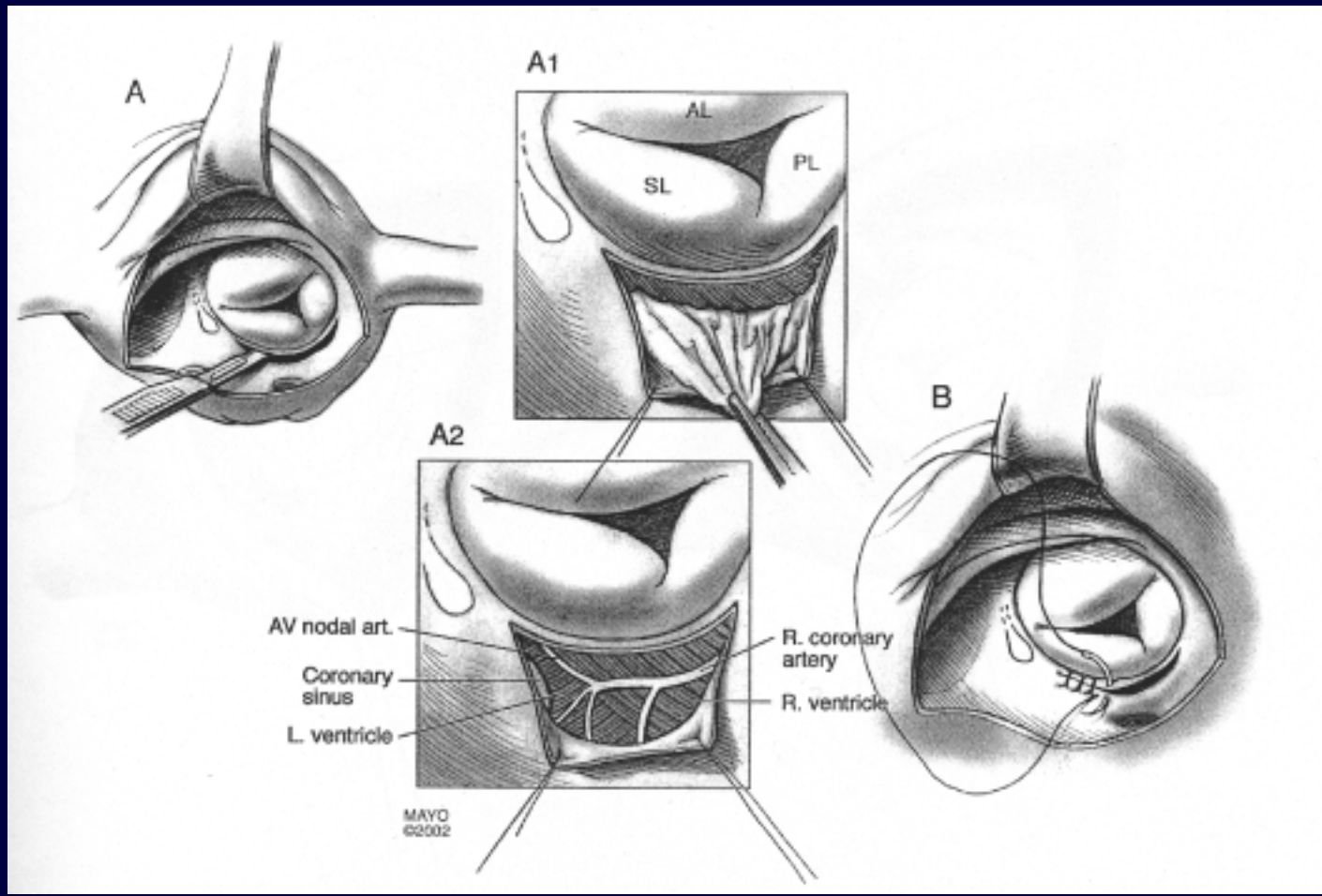
- may have ***epicardial course***
- limiting the success of ablation using an endocardial catheter approach.

Right - sided pathways ;

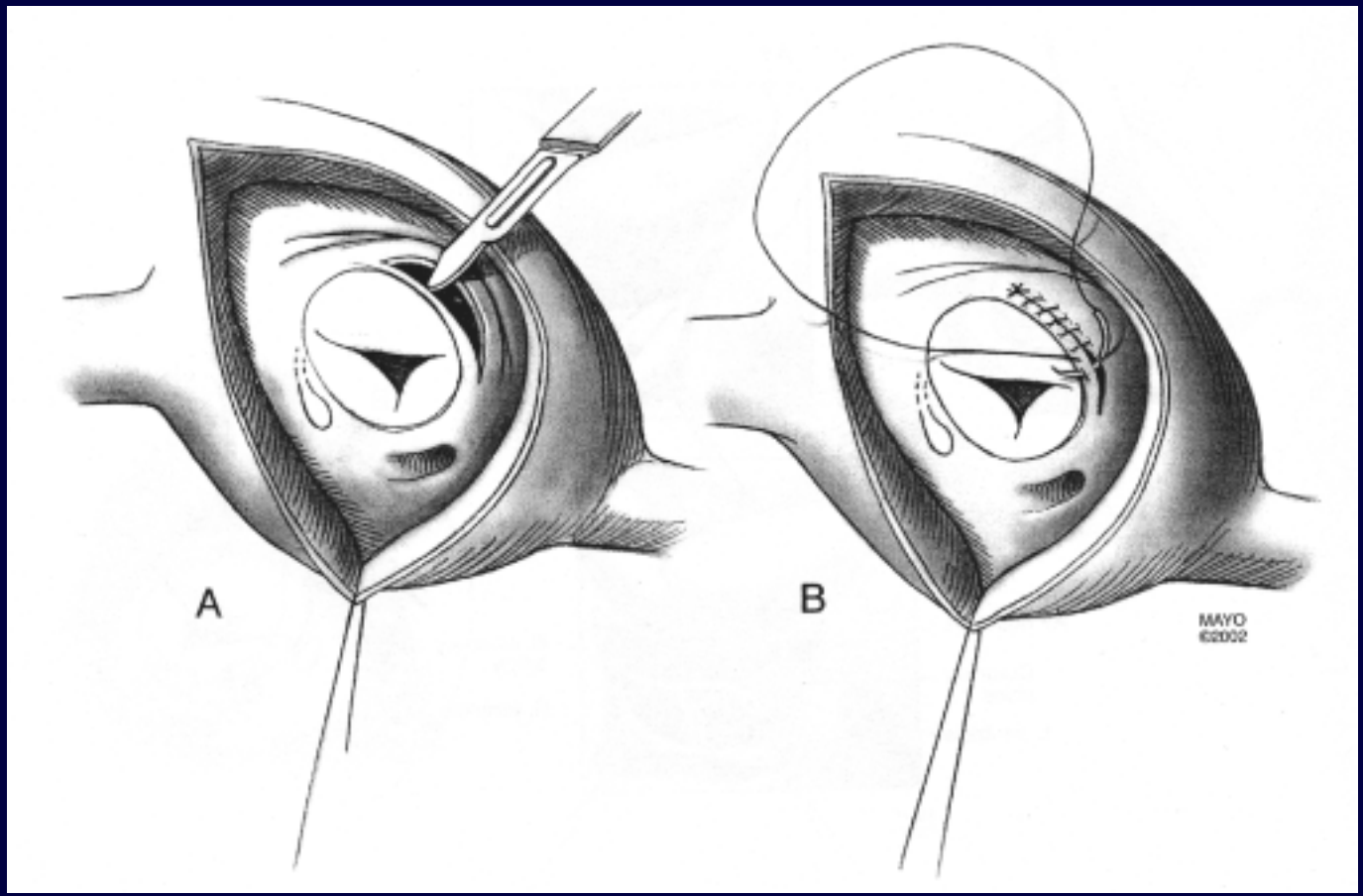
- tend to be **multiple, broad, difficult to localize** in the patients with **Ebstein's anomaly**
- recurrence risks for preexcitation are significantly higher

Surgical division

Posterior septal accessory conduction pathway



Lateral right free wall accessory pathways



Atrial reentry tachycardia

Incidence

- Most common form of SVT after operation for CHD
- 20-50 % of postoperative Senning or Mustard patients
- **40-50 % of Fontan patients**
- 34% of Tetralogy of Fallot patients

Transcatheter ablation

- Acute success rates of 30- 80 %
- Short-term recurrence rates for certain types of heart disease greater than 50%
- Require many hours for completion

Contributing factors

- Chronic atrial hypertension and dilatation
- Distorted anatomy
- Multiple reentrant circuits
- Restricted catheter access following lateral tunnel type repairs
- Inability to deliver radiofrequency lesions of sufficient depth to create a line of block

Fontan conversion and Maze procedure

Drs Mavroudis, Deal, and Backer

Children's Memorial Hospital,

Chicago

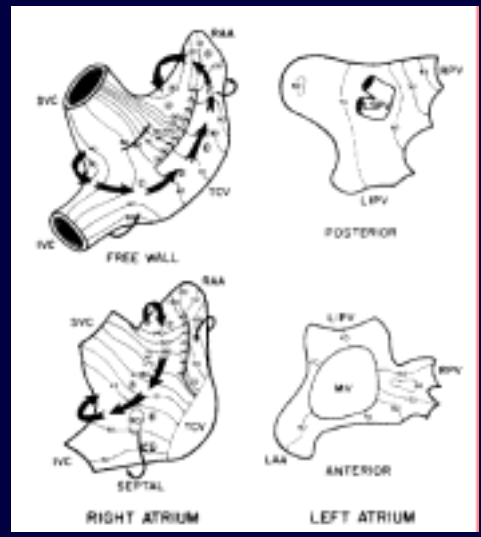
Reduction atrioplasty

Elimination of high pressure atrium

Perioperative atrial antitachycardia pacemaker placement

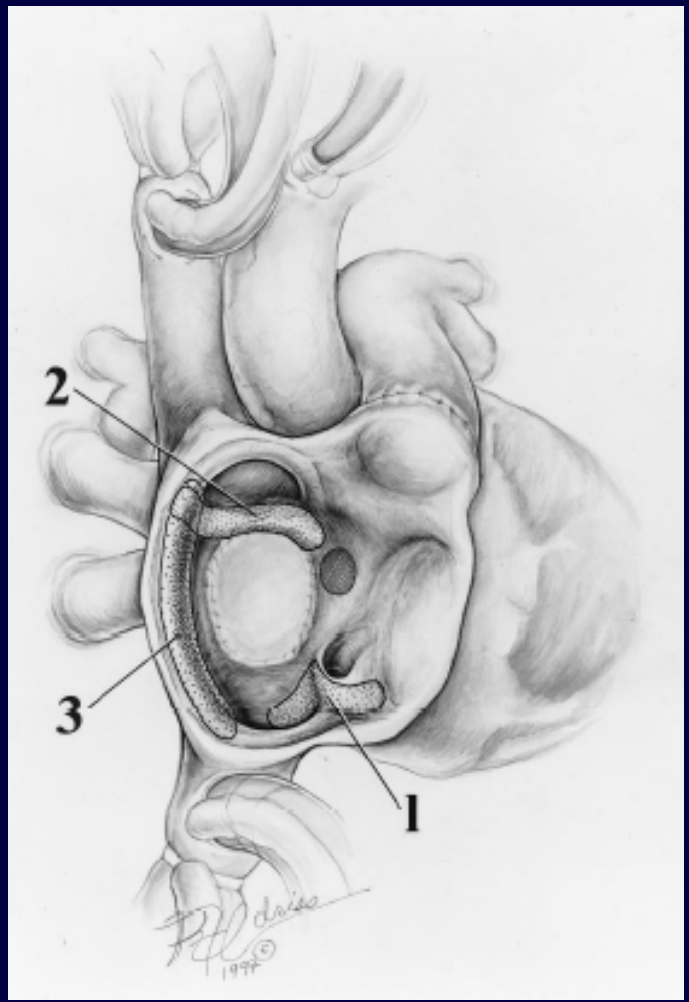
Animal study by Gandhi, 1996

Preexisting Fontan atrial suture lines are critical to the pathogenesis of IART



Modified Right-sided Maze for atrial reentry tachycardia

3 major tachycardia circuits



1. Inferomedial right atrium

   Between TV annulus and CS os

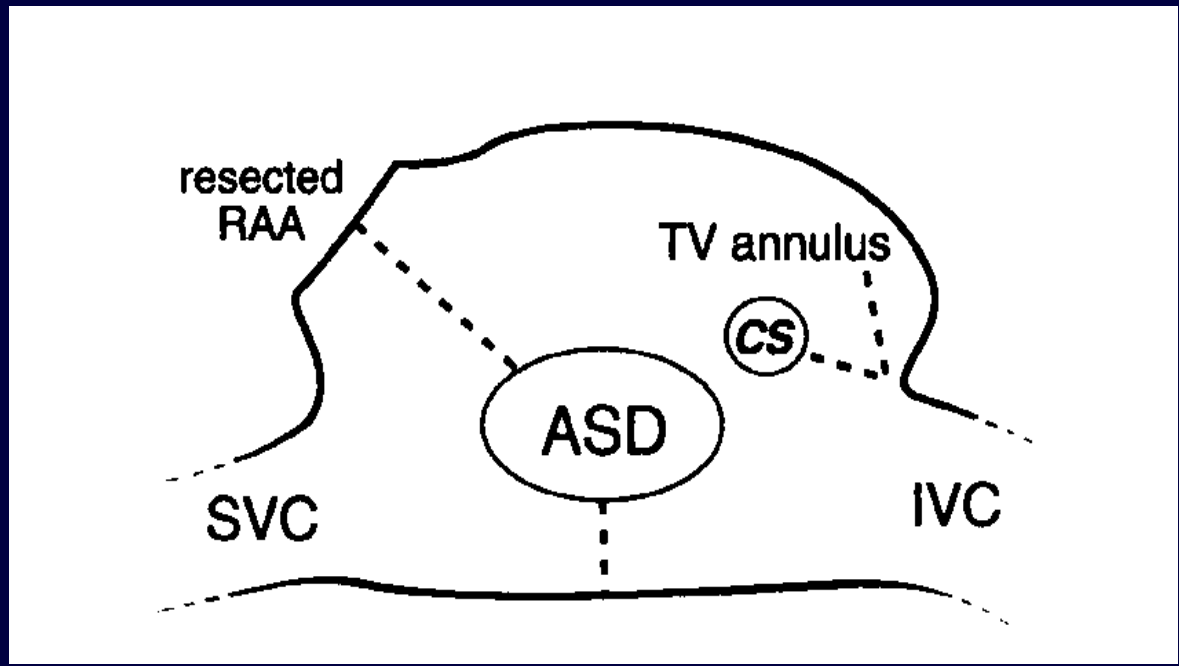
   Between CS os and IVC

2. Horizontal lesion from the superior rim of the ASD patch

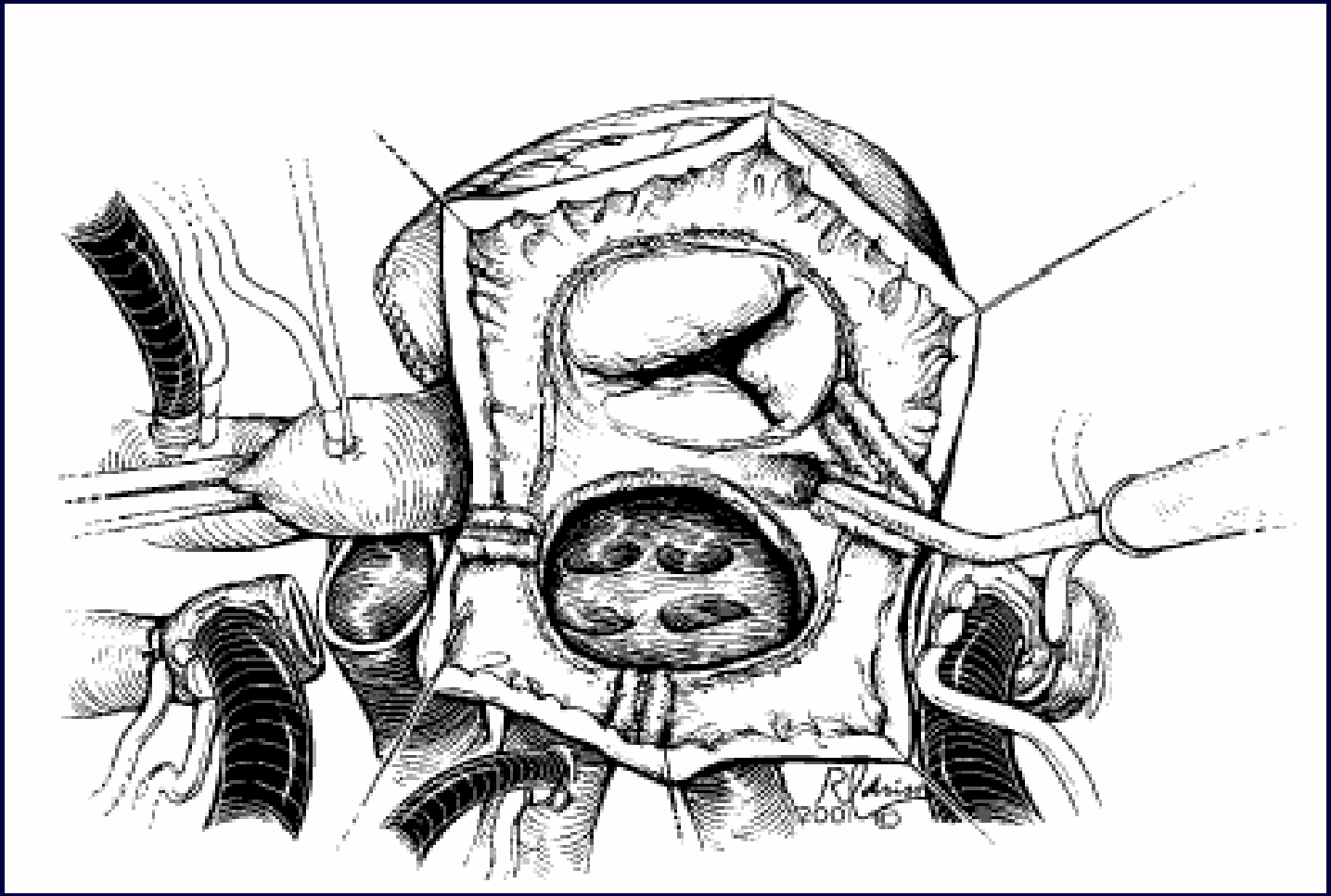
3. Vertical lesion from the SVC os to to the IVC os

Modified right atrial Maze procedure

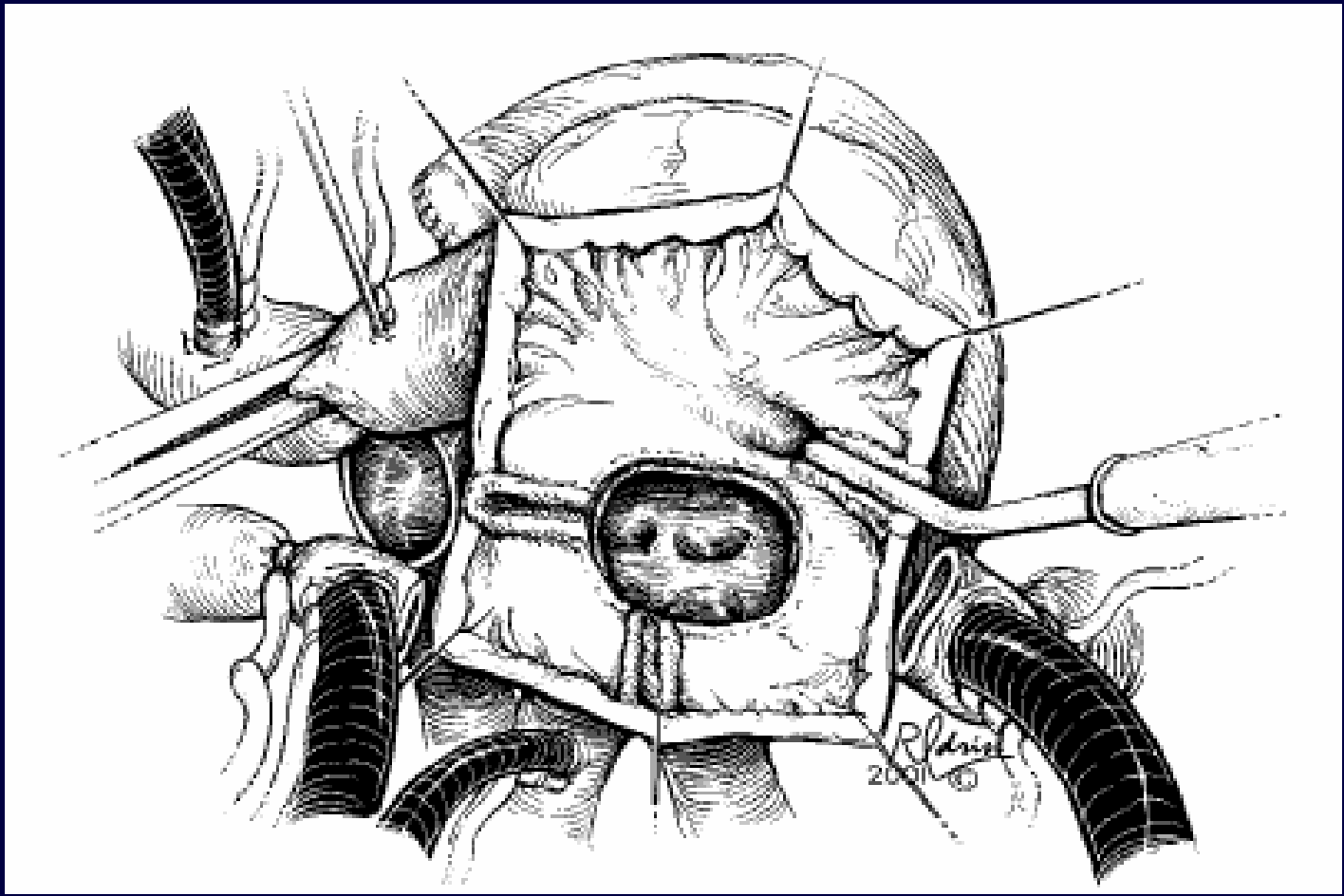
- Resection of large section of anterior right atrial wall
- Incision from SVC to IVC (along the crista terminalis)
- Cryoablation



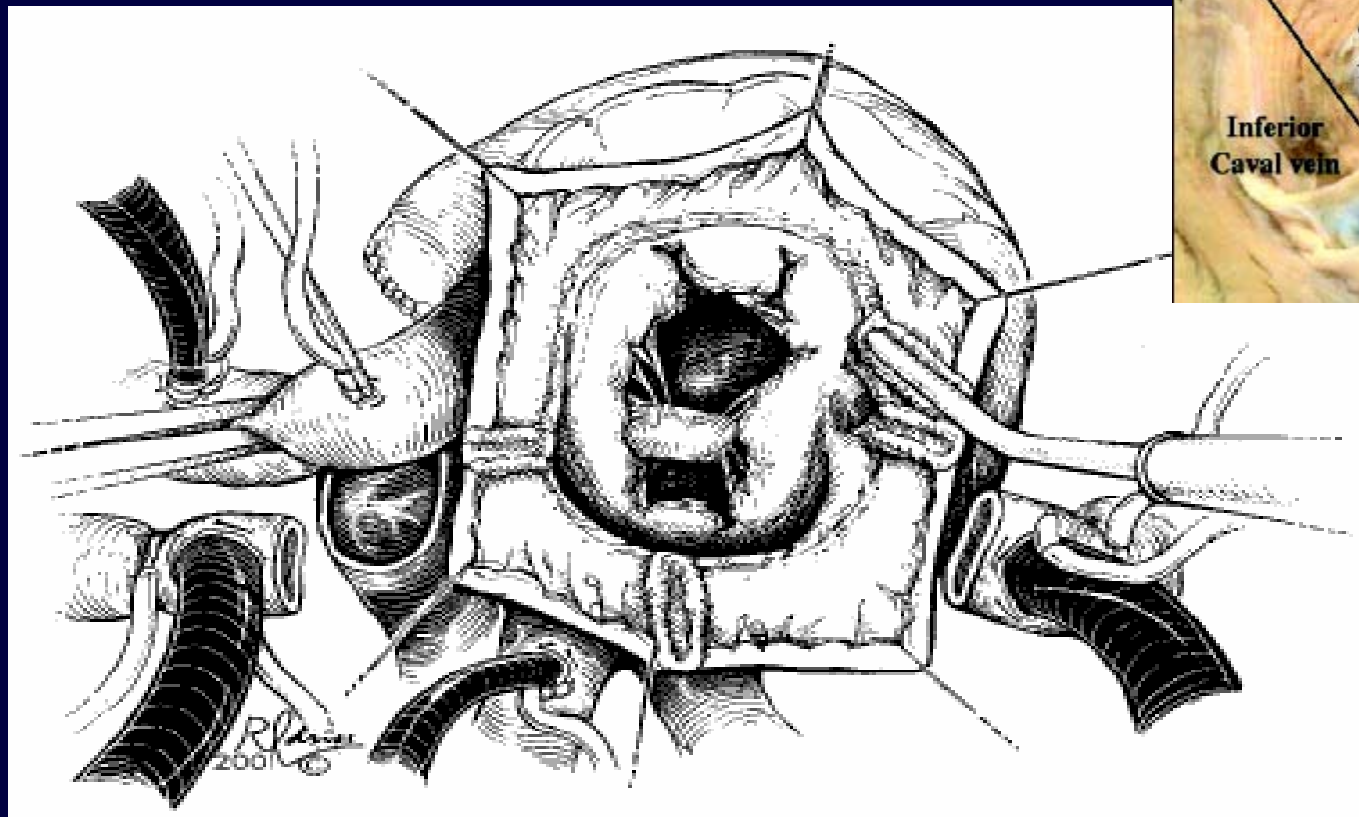
Double outlet right ventricle with mitral atresia

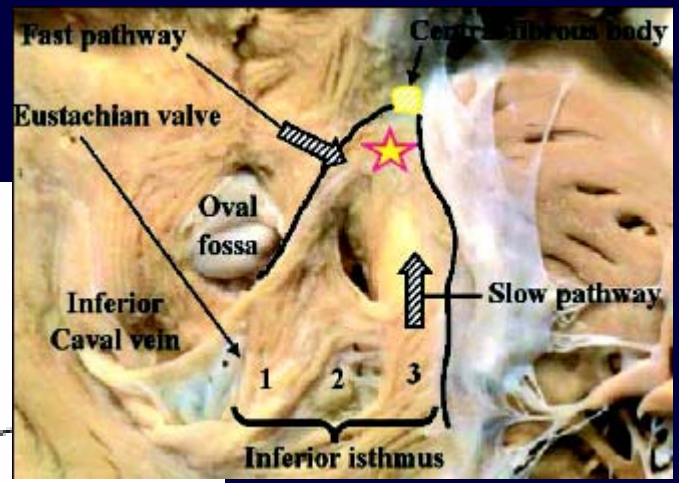


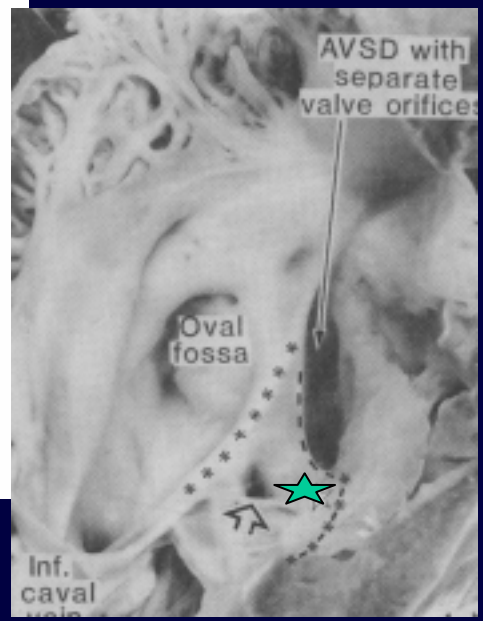
Tricuspid atresia



Single ventricle with unbalanced AVSD

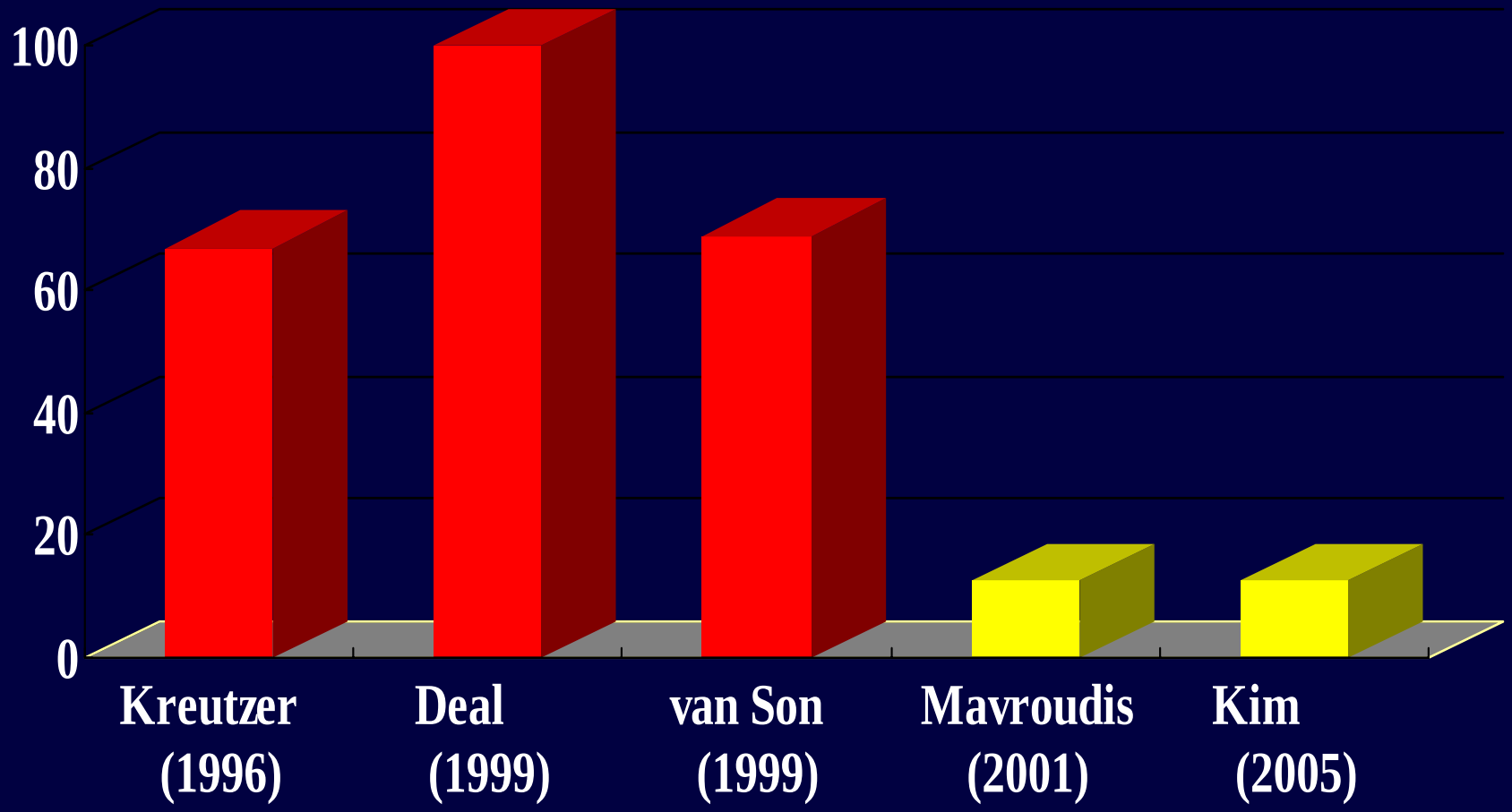






Recurrence rate of arrythmia

- Fontan conversion without arrythmia surgery
- Fontan conversion with arrythmia surgery

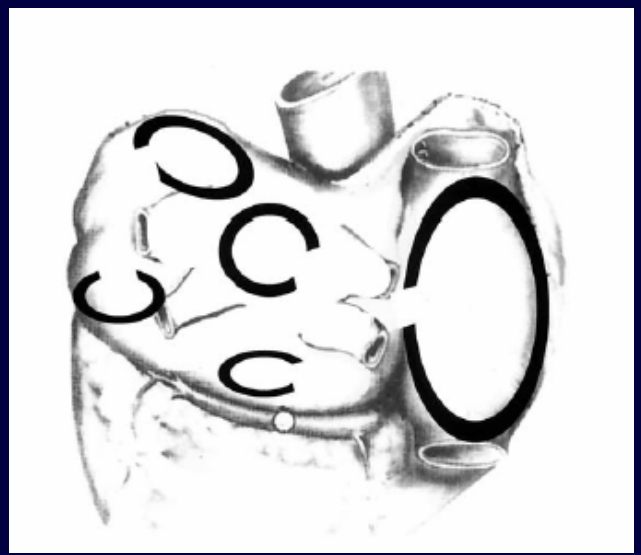


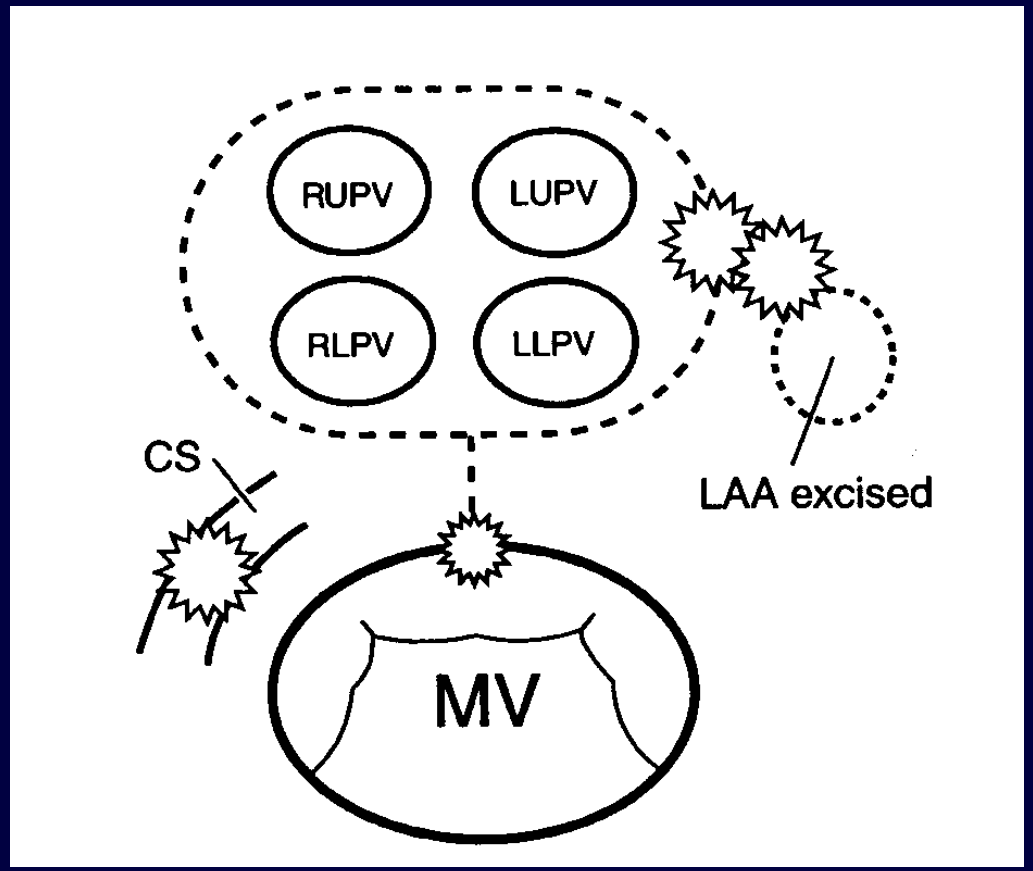
Atrial fibrillation

Cox – Maze III

Memorial Hospital

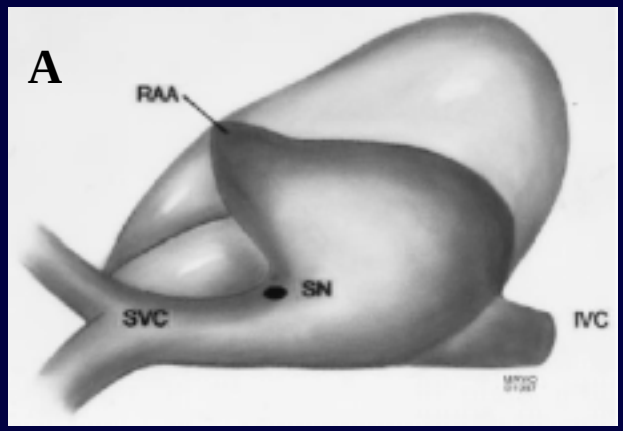
Mavroudis et al.

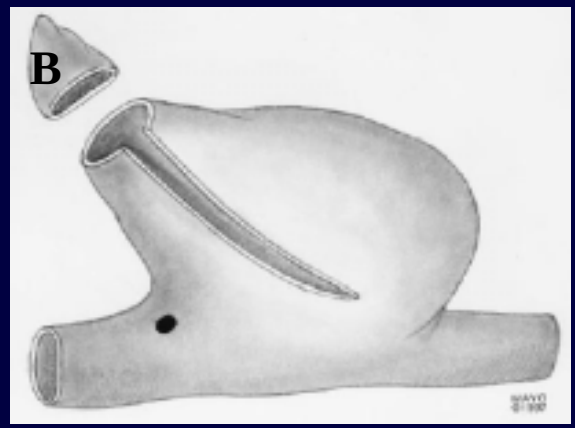


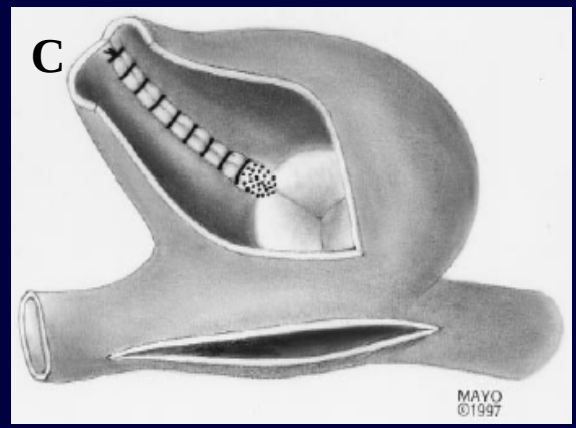


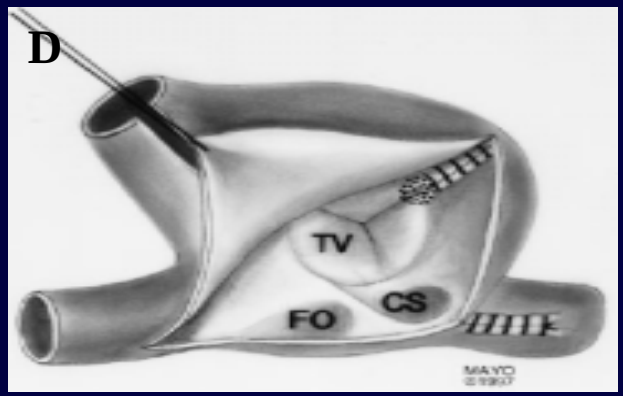
Right-sided Maze procedure for right atrial arrhythmia in CHD

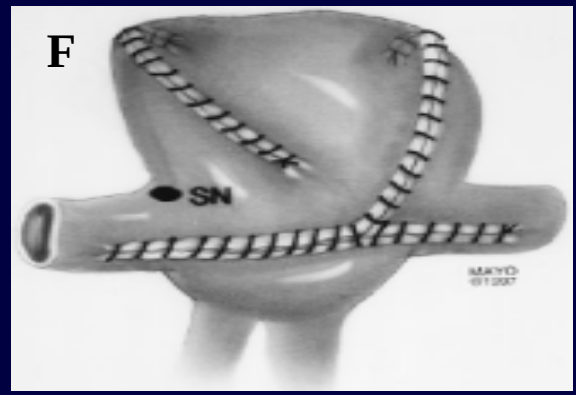
Theodoro et al. Mayo clinic (1998)











Presentation at 41th annual meeting of the STS

Mayo clinic

From 1993- 2003, **99 patients** with CHD and **AFI/F**

Median age, 43 years

Primary diagnosis - Ebstein's anomaly (n= 47)

- other congenital TR (n= 19)
- univentricular heart (n=11)
- isolated ASD (n=8)
- TOF (n=8)
- others (n=6)

Free of AFI/F - Mean F/U period, 2.7 years (up to 8 years)

- 77 of 83 early survivors (77%)

- no difference between paroxysmal vs chronic

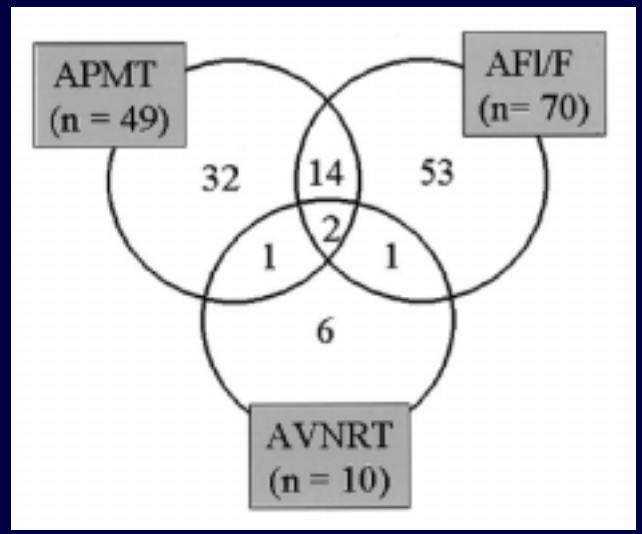
Supraventricular tachyarrhythmias in Ebstein anomaly: Management and outcome

Anant Khositseth, MD,[a] Gordon K. Danielson, MD,[b] Joseph A. Dearani, MD,[b] Thomas M. Munger, MD,[c] and Coburn J. Porter, MD[a]

From 1990- 2001, **130 patients** with CHD and **AFI/F**

Median age, 25 years

EP study in 109 pts



Free of APMT or AVNRT - mean F/U period, 57 months

- 6 of 6 survivors (100%)

Free of AFI/F - Mean F/U period, 34 months

- 41 of 44 late survivors (93%)

- no difference between RA maze vs isthmus abl.

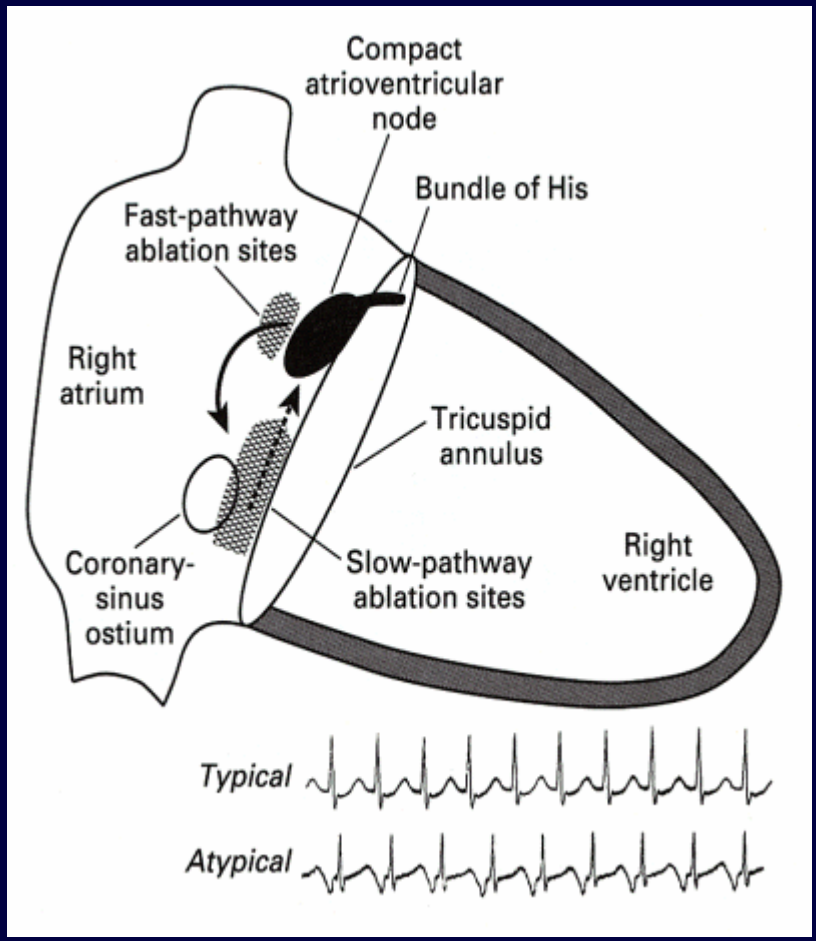
Advantages

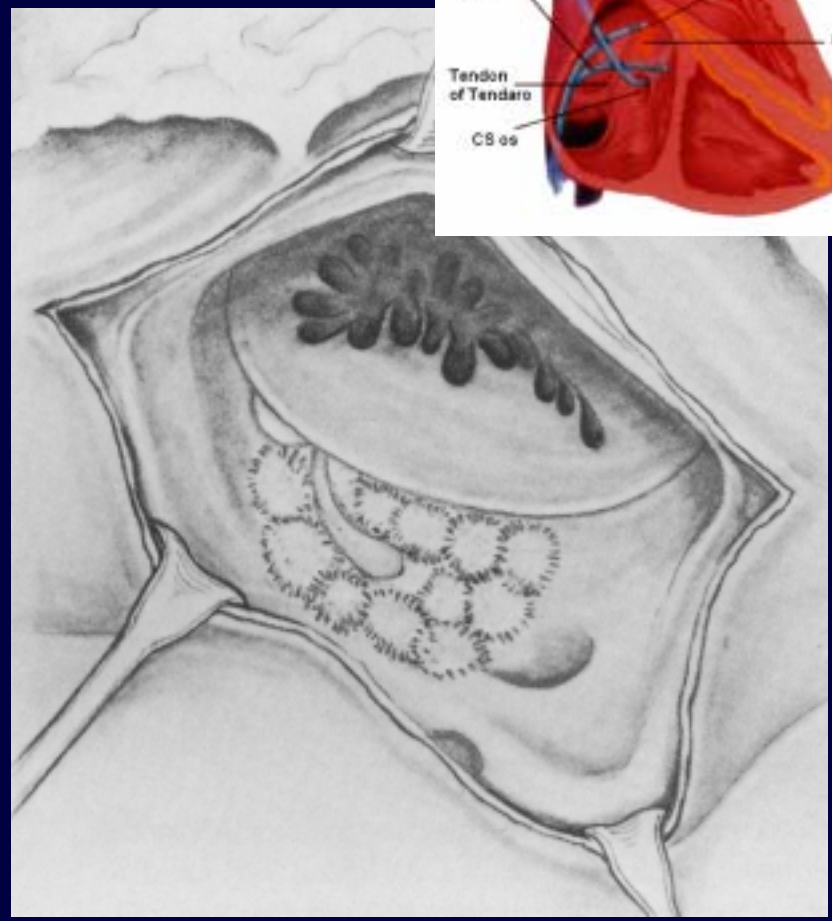
- Minimizing dissection of adhesions
- Shorter cardiopulmonary bypass time
- Limited total number of suture lines
- Minimizing the risk of bleeding behind the heart
- Preventing a possible postoperative non-contractile left atrium and the subsequent risk of systemic embolization

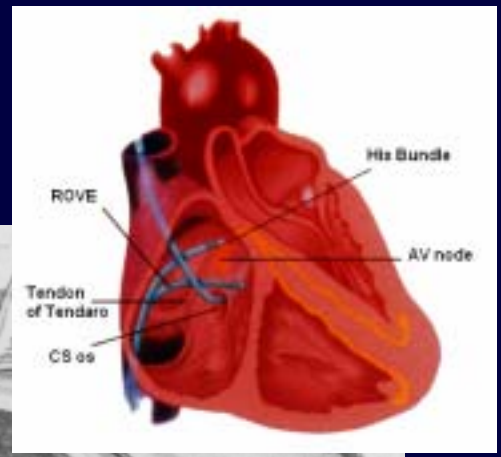
Disadvantages

- possibility of the left atrium also being a substrate for atrial fibrillation
- not removing the left atrial appendage as a potential source of thromboembolism

AV nodal reentrant tachycardia







Intraoperative interruption

Indications

In patients with prior Mustard or Senning procedures undergoing reoperation

Cryolesions

- Anterior to the coronary sinus & adjacent to the tricuspid annulus
- Along the superior (atrial side) of AV node

Success of surgical ablation for SVT

- **through understanding of the anatomic features referable to the specific congenital anomaly**
- **resection of excess atrial tissue** including previous atrial incisions
- establishing **lines of block** in areas that have been previously shown to be **critical parts** of a re-entrant circuit
- establish **atrial pacing**, especially when sinus node dysfunction exists

Less successful in surgical ablation

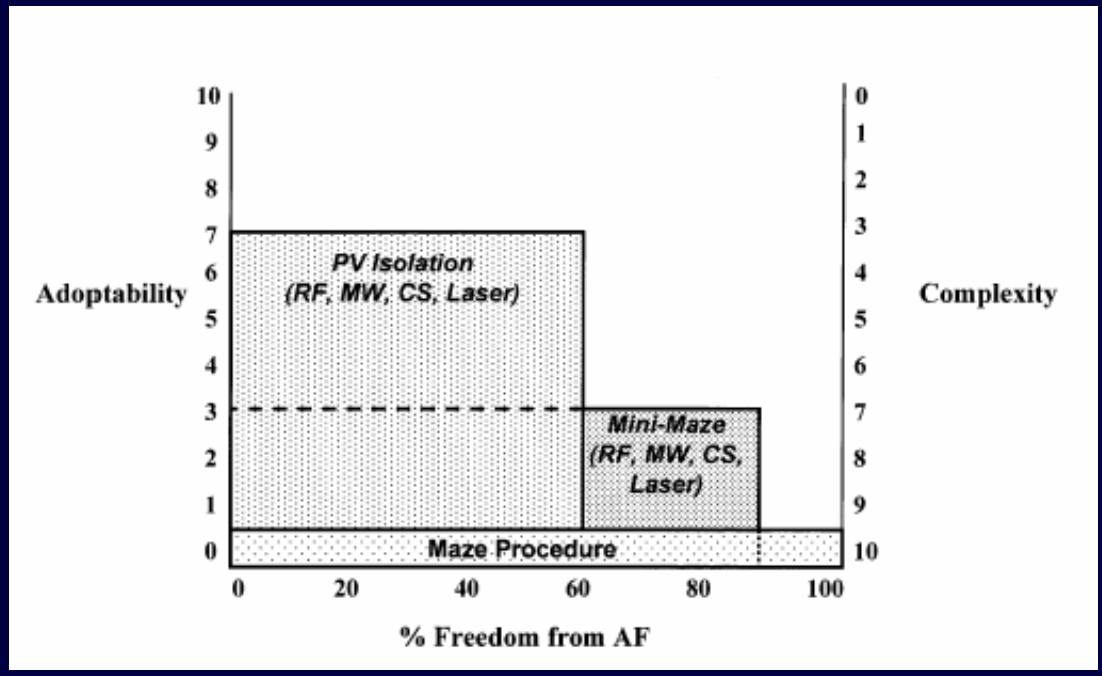
- Abnormal accessory connection(s) location (s), such as between the aortic and mitral valve, is possible (as in the case of **DORV with aorto-mitral discontinuity** due to subaortic conus

- Concern over the **location of the AV node** may also be a limiting factor, especially in cases of heterotaxy syndrome and tricuspid atresia with a tricuspid dimple, unbalanced AVSD

In the future

- More **detailed electrophysiologic mapping** in complex forms of single ventricle

- Comparison of long-term results between **right sided Maze procedure vs bi-atrial Maze** procedure in the patients with congenital heart disease and atrial fibrillation


Adoptability
Complexity
PV Isolation
(RF, MW, CS, Laser)
Mini-Maze
(RF, MW, CS, Laser)
Maze Procedure
10
9
8
7
6
5
4
3
2
1
0
0
1
2
3
4
5
6
7
8
9
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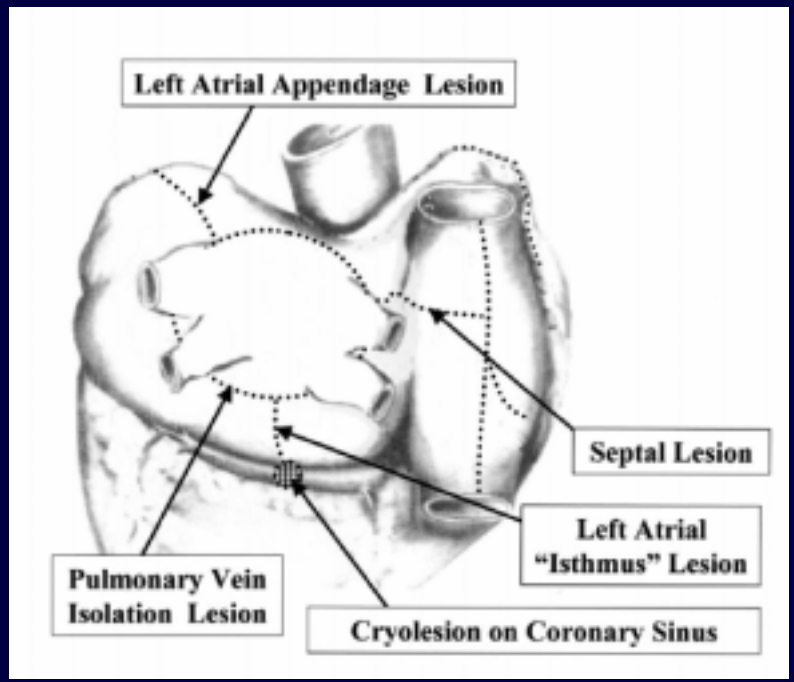
0
20
40
60
80
100
% Freedom from AF


Left Atrial Appendage Lesion
Septal Lesion
Left Atrial
"Isthmus" Lesion
Pulmonary Vein
Isolation Lesion
Cryolesion on Coronary Sinus