How to Manage Patients Who Have Failed Surgical Ablation Atrial Fibrillation and Flutter

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Case Presentation

• 59 yr old with h/o ASD and Paroxysmal atrial fibrillation and flutter
  – Typical Flutter ablation (CTI) previously in outside institution
  – Recurrences of A fib
  – Failed Rythmol, Amiodarone and Sotalol

• 2015 –
  – Surgical Closure of a sinus venosus ASD and secundum ASD
  – Single vessel coronary artery bypass with LIMA to ramus
  – Cryo/RF MAZE procedure
1. Isolation of the PV
2. Box lesion around 4 PV's and posterior wall
3. Connecting lesion to Mitral annulus
4. RA incision
   - From RA incision to the TV annulus at 4 o'clock… and extended across the isthmus, deep into the coronary sinus
5. SVC-IVC lesion + SVC isolation
6. RAA to the TV annulus

The atrial septal defects closed with direct sutures.
Follow up

• Recurrence of Atrial Flutter with ventricular rate ~135 bpm → failed DCC (early recurrence) with Sotalol

• Echocardiogram showed drop of LVEF: 55% → 36%
  – Biventricular dysfunction / Bi-atrial enlargement
  – Tachycardia induced cardiomyopathy?

Amiodarone started
Baseline ECG
Baseline Intracardiac Recordings

Atrial Tachycardia/ Slow Atrial Flutter with 1:1 AV conduction
LA activation map
Confirmed with entrainment

Pentarray in LA

Concealed entrainment PPI~TCL

Concealed entrainment PPI~TCL
Voltage maps
Mitral Isthmus line: LIPV-MV

1. Flutter Terminates

• Recurrence of Afib with organization into Flutter #2
A Flutter
RA Voltage and Activation Maps

Intercaval Line

Site of block at CTI ablation
Entrainment Mapping

Poor entrainment
PPI >> TCL

Concealed entrainment
PPI ~ TCL

Pentarray in LA
Voltage and activation Map

Voltage Map

Activation Map
• CS is surrounded by sleeve of muscular tissue inputs that are connected to LA musculature.

• In this case: Incomplete ablation dissociated the CS from LA and created region of slow conduction to allow for unusual primary CS circuit.
Ablation within the CS

Flutter Termination
Post ablation

Frequent PAC’s and Repeated bursts of Parox. Afib…. No Flutter

Time to check the PV’s
Voltage maps

- Check the PV’s
- Check the SVC
- If silent → Non-PV triggers
  - CS, LAA, CT
Mapping the RIPV: *Not isolated + Triggers*

- Impulse going in the PV during NSR
- Triggers from PV going out to the atrium
RIPV: Post Isolation

Entry Block

Exit Block

Isolated with dissociated firing
Maintained NSR

Pre Ablation

Post Isolation

PV isolated

Lasso in RIPV
Still need to check adequacy of
- Mitral Isthmus line
- CTI line.
LAA to CS post Mitral line

Pentarray in LAA
Voltage maps: PW isolation
Re-induction attempts with Burst Pacing-Multiple locations

Burst Pacing at 250 bpm: No induction
Summary

• Mitral-annulus to LIPV line.
• CS ablation
• **Re-isolation of PV’s**
• PW ablation

• Confirmed isolation of PV’s and SVC
• Confirmed bidirectional block across the lines (MV, CTI, Roof)

• Unable to induce any flutters at the end of the procedure
Post MAZE Arrhythmias

- Atrial Tachyarrhythmias: AF, AFL, AT, Combo…
  - Late recurrence: 3-50% (The more you look, the more you see)
  - Predictors:
    - LA size, Age, AF duration
    - Surgical techniques: tools, lesion set, validation.

Difficult to manage medically
Persistent, fast, highly symptomatic, refractory to medical therapy.
Post MAZE Arrhythmias: Mechanisms

1. Gaps in the lines
   - PV not isolated
   - Lesion not extending to anatomic boundary (Intercaval line)
   - Failure of the terminal connection (Cryo at CTI, Mitral line)

2. Uncovering Anisotropic conduction (Bachman’s bundle, Crista Terminalis, CS)

3. Non PV triggers (LAA, CS…)

4. “Bad substrate”: need for mechanistic mapping

Macro-reentry
Focal origin
AFL / AT /AF
Common Flutter Circuits

- Peri Mitral Flutter
- Roof Dependent Flutter
- Right sided flutter CTI; Incisional
Atrial Arrhythmias After Surgical Maze

Findings During Catheter Ablation

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OBJECTIVES
We describe the clinical and electrophysiologic characteristics and management of post "cut and sew" Maze arrhythmias in symptomatic patients.

BACKGROUND
The Cox Maze procedure was developed as a surgical treatment of atrial fibrillation. Until recently, invasive electrophysiologic studies in patients with symptomatic post-operative arrhythmias in this patient population have not been described.

METHODS
The management and clinical course of consecutive patients with post-Maze arrhythmias refractory to antiarrhythmic drugs (AADs) between January 2000 and December 2003 are presented.

RESULTS
Twenty-three patients (15 men) presented 14 ± 14 months after Maze surgery for treatment of atrial fibrillation (AF). Eight patients underwent "cut and sew" Maze for lone AF with no other surgical indication. Fifteen patients underwent the "cut and sew" Maze procedure in addition to another surgical procedure: mitral valve surgery (11 patients) and coronary artery bypass graft surgery (4 patients). Eight patients (35%) had recurrent AF secondary to recovered conduction around the lines encircling the pulmonary veins. Five patients were documented to have focal atrial tachycardia, which was mapped to the coronary sinus in 3 patients, to the posterolateral right atrium in 1 patient, and to the left atrial (LA) septum in 1 patient. Four patients had right atrium incisional atrial flutter (AFL), and 6 had LA incisional AFL, which was mapped around the mitral valve annulus in 4 patients and around the right pulmonary veins in 2 patients. Twenty-two of the 23 patients were treated successfully with radiofrequency ablation. At 1-year follow-up, 19 patients were arrhythmia-free and taking no AADs.

CONCLUSIONS
After surgical "cut and sew" Maze, approximately one-third of patients experiencing atrial arrhythmias have AF secondary to pulmonary vein-left atrium conduction recovery. Moreover, incisional AFL seems to be a common finding in this group of patients. Catheter-based mapping and ablation of these arrhythmias seems to be feasible and effective. (J Am Coll Cardiol 2006;48:1405–9) © 2006 by the American College of Cardiology Foundation
Atrial Arrhythmias After Surgical Maze
Findings During Catheter Ablation

23 patients
14 ± 14 months post “cut & sew” Maze surgery

| Age (yrs) | 64 ± 12 |
| Gender | 15 men |
| AF surgery alone (n) | 8 |
| AF surgery + CABG (n) | 4 |
| AF surgery + mitral valve surgery (n) | 11 |

Arrhythmia on presentation (n)

- AF: 8
- AT: 5
- AFL: 10

Recovered conduction in PV
CS:3 / RA:1 / LA:1
Peri Mitral: 4 / Peri PV: 2 / RA incisional: 4

22/23 patients treated with RFA → 19 patients arrhythmia free @1 yr on No AAD’s
Ablation of the LAA “stump” to cure post surgical maze patients.
Proarrhythmic Aspects of Atrial Fibrillation Surgery
Mechanisms of Postoperative Macreentrant Tachycardias

• AT post AF surgery (>8 weeks):
  − 22 of 143 pts (15%)
• 25 tachycardias mapped
• All treated with catheter ablation
• No recurrences in long-term follow-up.


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Post MAZE Late Arrhythmias: Management

• Anticoagulation and Rate control

• Antiarrhythmic medications
  – Consideration after attempted catheter ablation

• **Catheter ablation …Nature of the rhythm**
  – Afib: Ensure PV isolation, Non PV triggers, Check lines
  – Aflutter: Map and ablate clinical flutter + associated flutter
    – Plug the gaps, Isolate PV +PW, Non PV triggers, Check lines

  **Beware**
  More ablation → more potential flutter circuits

• AVJ ablation + PPM (His bundle pacing)
His Bundle Pacing
Post MAZE Arrhythmias

• Atrial Tachyarrhythmias

• Iatrogenic
  1. Sinus node isolation
  2. Interatrial conduction delay
1. Sinus Node isolation
2. Intra-atrial conduction delay $\rightarrow$ Delayed LA contraction $\rightarrow$ simultaneous with Ventricular systole.
2. Intra-atrial conduction delay → Atrial Dyssynchrony

Is it better than Afib??
Conclusions

Post MAZE Arrhythmias

• Atrial Tachyarrhythmias:
  – Macroreentry, gaps; Lt and Rt atrium
  – Catheter ablation

• Sinus Node Dysfunction: PPM

• Iatrogenic: SND, IAC delay
Questions

• What Can I tell the surgeon to help improve the success of the MAZE
  – Biatrial vs. Lt sided Maze only
  – Intercaval lesion?
  – LAA stump isolation?
  – Value of checking for block intra op.
  – LoM, Ganglionic Plexi etc…?
  – Role of mechanistic mapping (epicardial?)
  – Evaluation of intra/interatrial conduction
Thank You