Surgical Treatment of Atrial Fibrillation: Current Concepts

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Título da Apresentação:
Surgical Treatment of Atrial Fibrillation: Current Concepts

Não possuo nenhum conflito de interesse relacionado a esta apresentação

I have no conflicts of interest, financial relationships or affiliations, related to this presentation, to disclose
Besides strong evidences of increased morbidity, stroke and mortality rates related to AF, a significant number of patients is left untreated, even with readily available common anticoagulants.

Clinical trials comparing sinus rhythm reversion with rate control present confounding results. Limited trials designs contribute to increased confusion.

In catheter ablation and surgery, the diversity of methods and outcomes further confounds comparison of results.
It has been well demonstrated that ablation and surgery, after qualified indication, selection and treatment, results in more than 90% recovery of sinus rhythm, with low procedural risk.

Whether or not this corresponds to less clinical outcomes has not yet been proved by randomized clinical trials. In current ongoing investigation studies, there are no perspectives of consensus on sight.

Market issues contamination, in disregard to medical specialties collaboration/integration, further compromises a consensus.
AF pathophysiology, burden and management are not familiar to many surgeons.

Adding a new and controversial procedure to established techniques is a difficult task.

In this scenario, to describe the real space for AF surgery is a great challenge.

The exceptions are in the setting of mitral valve disease and in the practice of surgeons or centers devoted to AF treatment.
Treatment Goals and Strategies

- Rate control
  - Pharmacologic: Ca\(^{2+}\) blockers, β-blockers, Digitalis, Amiodarone
  - Nonpharmacologic: Ablate and pace
- Maintenance of SR
  - Pharmacologic: Class IA, Class IC, Class III, β-blocker
  - Nonpharmacologic: Catheter ablation, Pacing, Surgery, Implantable devices
- Stroke prevention
  - Pharmacologic: Warfarin, Aspirin, Thrombin Inhibitor
  - Nonpharmacologic: Removal/isolation, LA appendage

Prevent Remodeling
- CCB, ACE-I, ARB, Statins, Fish oil

Hugh Calkins, Johns Hopkins Medical Institutions
### Adjusted stroke rate according to CHA₂DS₂-VASc score

<table>
<thead>
<tr>
<th>CHA₂DS₂-VASc score</th>
<th>Patients (n = 7329)</th>
<th>Adjusted stroke rate (%/y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>0%</td>
</tr>
<tr>
<td>1</td>
<td>422</td>
<td>1.3%</td>
</tr>
<tr>
<td>2</td>
<td>1230</td>
<td>2.2%</td>
</tr>
<tr>
<td>3</td>
<td>1730</td>
<td>3.2%</td>
</tr>
<tr>
<td>4</td>
<td>1718</td>
<td>4.0%</td>
</tr>
<tr>
<td>5</td>
<td>1159</td>
<td>6.7%</td>
</tr>
<tr>
<td>6</td>
<td>679</td>
<td>9.8%</td>
</tr>
<tr>
<td>7</td>
<td>294</td>
<td>9.6%</td>
</tr>
<tr>
<td>8</td>
<td>82</td>
<td>6.7%</td>
</tr>
<tr>
<td>9</td>
<td>14</td>
<td>15.2%</td>
</tr>
</tbody>
</table>

**Example:** Female (1), >65y (1), hypert (1), diabetes (1) = 4% stroke rate/year = 40% stroke risk in 10 years
AF Surgical Treatment

Risks

Mortality 1-2%
Morbidity ~10%

Benefits:

Stroke
Late Mortality
The Cox-Maze: A landmark procedure

- 1987 - Barnes Hospital, Washington University, St. Louis, Mo

James L. Cox
The Cox maze III procedure for atrial fibrillation: Long-term efficacy in patients undergoing lone versus concomitant procedures

### TABLE 2. Patient demographics

<table>
<thead>
<tr>
<th></th>
<th>Lone Maze procedure</th>
<th>Concomitant maze procedure</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>51.3 ± 10.5</td>
<td>58.8 ± 9.9</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Sex (M:F)</td>
<td>90:22</td>
<td>53:33</td>
<td>.003</td>
</tr>
<tr>
<td>PAF:PTAF</td>
<td>72:40</td>
<td>45:41</td>
<td>.08</td>
</tr>
<tr>
<td>Pump time (min)</td>
<td>162 ± 35</td>
<td>201 ± 42</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Crossclamp time (min)</td>
<td>93 ± 34</td>
<td>122 ± 37</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Mortality</td>
<td>2/112, 1.8%</td>
<td>1/86, 1.2%</td>
<td>.99</td>
</tr>
<tr>
<td>Median ICU stay (d)</td>
<td>2</td>
<td>3</td>
<td>.007</td>
</tr>
<tr>
<td>Median LOS (d)</td>
<td>9</td>
<td>12</td>
<td>.01</td>
</tr>
</tbody>
</table>

PAF, Paroxysmal atrial fibrillation; PTA, persistent atrial fibrillation; LOS, length of stay.

![Figure 1. Kaplan-Meier survival analysis of freedom from recurrent AF. The numbers on each line indicate the number of patients at risk. There was no difference in the long-term estimate of freedom from AF between the lone maze group (L) and the concomitant group (C; P = .54).](image)
Early and late stroke after mitral valve replacement with a mechanical prosthesis: Risk factor analysis of a 24-year experience

Conclusions

Persistent atrial fibrillation was the most significant risk factor for late stroke after mechanical mitral valve replacement. Restoration of sinus rhythm with a maze procedure nearly eliminated the risk of late stroke, whereas neither closure of the left atrial appendage nor therapeutic anticoagulation prevented this complication.

Ko Bando, MD; Junjiro Kobayashi, MD; Mitsuhiro Hirata, MD, et al. J Thorac Cardiovasc Surg 2003;126:358-64
Cox-Maze Procedure
(Cirurgia ou Procedimento do Labirinto, para FA)

Left Atrial Procedure for Atrial Fibrillation.
Técnica cirúrgica simplificada pode ser eficaz no tratamento da fibrilação atrial crônica secundária a lesão valvar mitral?


**IVP n=7**

**Labirinto n=57**

Rev Bras Cir Cardiovasc vol.15 n.2 São Paulo Apr./June 2000
Simple Surgical Isolation of Pulmonary Veins for Treating Secondary Atrial Fibrillation in Mitral Valve Disease

Renato A. K. Kalil, MD, PhD, Gustavo G. Lima, MD, MSc, Tiago L. L. Leiria, MD, Rogério Abrahão, MD, Leonardo M. Pires, MD, Paulo R. Prates, MD, and Ivo A. Nersalla, MD, PhD

Instituto de Cardiologia do Rio Grande do Sul, Fundação Universitária de Cardiologia, Porto Alegre, Brazil

Fig 1. Three-dimensional posterior view of the heart after the procedure showing the suture line around the four pulmonary veins, exclusion of left atrial appendage, and perpendicular incision directed into the mitral annulus. (Reprinted from Kalil RAK, et al, Ann Thorac Surg; 2002;73:1022, with permission.)
Surgical Technique: Cut & Sew Pulmonary Veins Isolation as box lesion
Randomized study of surgical isolation of the pulmonary veins for correction of permanent atrial fibrillation associated with mitral valve disease

Álvaro Albrecht, MD, Renato A. K. Kalil, MD, PhD, Luciana Schuch, MD, Rogério Abrahão, MD, João Ricardo M. Sant’Anna, MD, PhD, Gustavo de Lima, MD, PhD, FACC, and Ivo A. Nesralla, MD, PhD

FIGURE 1. A, Kaplan–Meier curve showing the number of patients at sinus rhythm as a function of time, according to surgical technique. B, Patient
Mini-Maze Procedure

“The box lesion”
(n = 4), root-dependent left A1 (n = 1), focal A1 arising from the coronary sinus (n = 1), and right-sided ATs (n = 2). All spontaneously running ATs were successfully eliminated using EAM and subsequent RF catheter ablation. No major complications were noted. Minor complications included 5 large groin hematomas (7.1%), defined as coloration of the skin covering an area larger than a clenched fist, and 1 atrioventricular fistula (1.4%).

Fig 1. Cardiac rhythm in patients after epicardial surgical ablation at beginning of electrophysiologic examination: atrial fibrillation (AF, green); atrial tachycardia (AT, red); right atrial flutter (RAFL, purple); and sinus rhythm (SR, blue).

Fig 2. Success rate of epicardially created circumferential and linear lines as assessed a median of 87 days after index procedure. (IVC = inferior vena cava; LAA = left atrial appendage; LIPV = left inferior pulmonary vein; LSPV = left superior pulmonary vein; RIPV = right inferior pulmonary vein; RSPV = right superior pulmonary vein; SVC = superior vena cava.)
The Cox-Maze Procedure for Lone Atrial Fibrillation
A Single-Center Experience Over 2 Decades

Cox-Maze Procedure for Lone Atrial Fibrillation

Table 3. Late Follow-up

<table>
<thead>
<tr>
<th>Variable</th>
<th>CMP III (n=112)</th>
<th>CMP IV (n=100)</th>
<th>CMP III+IV (N=212)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follow-up, median (IQR), y</td>
<td>5.9 (2.5–7.8)</td>
<td>1.0 (0.74–1.9)</td>
<td>2.2 (0.9–6.2)</td>
</tr>
<tr>
<td>Freedom from AF*</td>
<td>96 (86–98)</td>
<td>90 (81–95)</td>
<td>93 (87–96)</td>
</tr>
<tr>
<td>Freedom from AF off antiarrhythmics*</td>
<td>83 (68–88)</td>
<td>82 (71–89)</td>
<td>82 (75–87)</td>
</tr>
<tr>
<td>Freedom from warfarin*</td>
<td>86 (75–92)</td>
<td>74 (62–83)</td>
<td>80 (72–86)</td>
</tr>
<tr>
<td>Late stroke (≥30 d), no. (%)</td>
<td>1 (0.8)</td>
<td>0</td>
<td>1 (0.4)</td>
</tr>
</tbody>
</table>

*Data are given as mean (95% CI).

Effectiveness of Surgical Ablation of Atrial Fibrillation during Mitral Valve Surgery: A Randomized Clinical Trial from the Cardiothoracic Surgical Trials Network

**Purpose:** For patients who have persistent or long-standing persistent (LSP) atrial fibrillation (AF) and are having mitral valve surgery, this trial compares effectiveness of surgical ablation to no surgical ablation.

**Trial Design:** Phase 2, interventional, randomized, parallel, single blind (outcomes) study. Mitral valve surgery (MVS) + ablation vs. MVS alone. N= 260. Mean f/u=21 months.

**Primary Endpoint:** number of patients free of AF at 6 and 12 months

<table>
<thead>
<tr>
<th>Trial Results</th>
<th>MVS + ablation</th>
<th>MVS alone</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AF Free</td>
<td>63%</td>
<td>29%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mortality @ 1 year</td>
<td>6.8%</td>
<td>8.7%</td>
<td>0.55</td>
</tr>
<tr>
<td># Requiring permanent pacemaker</td>
<td>21.5</td>
<td>8.1</td>
<td>0.01</td>
</tr>
</tbody>
</table>

**Conclusions:** A significant number of patients were free of AF at 1 year when ablation was used with MVS. More patients who received ablation required a permanent pacemaker. Other endpoints were similar with both approaches.

Presented by: A. Gillinov, ACC.15, San Diego, CA
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A systematic review of minimally invasive surgical treatment for atrial fibrillation: a comparison of the Cox-Maze procedure, beating-heart epicardial ablation, and the hybrid procedure on safety and efficacy

\[ n = 1877 \text{ in 37 selected reports} \]

61,201 mitral valve procedures

- MVrepair = 57.4% (35,114 of 61,201)
- MVReplacement = 42.6% (26,087 of 61,201)
- AF present = 32.2% (19,689 of 61,201)
- Surgical ablation procedure performed in 61.5% of these patients (12,102 of 19,689).


Brazilian ByPass Registry: AF + Valve = 12/1722 = 0.7%
Surgical Efficacy

- Depends on transmurality and lesions design
- “Cut &Sew” warrants transmurality
- RF, cryo, microwaves, diathermy, ultrasound, etc are associated to variable success indices
- Complete PV isolation in a “box lesion” like design confers > 90% SR (similar to Cox-Maze III/IV) in all AF modalities, being lone or associated to structural disease, paroxysmal or long term.
Surgical Risks

- Surgical mortality when associated ~ = 2%
- Surgical mortality for lone AF ~ = 1%
- Morbidity ~ = 10% (reop for bleeding, prolonged ventilation and LOS, infection, bradycardia, pacemaker, others)
## Estimated Outcomes and Risks of AF Ablation

<table>
<thead>
<tr>
<th>Success</th>
<th>Single Procedure</th>
<th>Multiple Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimal patient</td>
<td>60% - 80%</td>
<td>80% - 90%</td>
</tr>
<tr>
<td>Less optimal patient</td>
<td>50% - 70%</td>
<td>70% - 80%</td>
</tr>
<tr>
<td>Poor candidate</td>
<td>&lt; 40%</td>
<td>40% - 60%</td>
</tr>
</tbody>
</table>

### Major complication rates:

- **Left atrial flutter**: 2% - 5%
- **Vascular/access related**: 1% - 5%
- **Cardiac tamponade**: 0.5% - 3%
- **Stroke**: 0.5% - 2%
- **PV stenosis**: < 1%
- **Phrenic nerve injury**: < 0.5%
- **Esophageal perforation**: < 0.2%
- **Mitral valve entrapment**: < 0.1%
- **Acute coronary occlusion**: < 0.1%
- **Death**: < 0.1%

The estimates provided on this table are not based on the outcomes of large prospective multicenter clinical trials. These estimates are based on a review of the published literature. It is recognized that the outcomes of AF ablation depend on a large number of variables including those shown in the table. In addition, the technique and tools used may also impact outcomes. And finally, the experience of the operator and of the ablation center at which the procedure is performed also impact success and complication rates.
6.5. Surgical Maze Procedures: Recommendations

CLASS IIa

1. An AF surgical ablation procedure is reasonable for selected patients with AF undergoing cardiac surgery for other indications. *(Level of Evidence: C)*

CLASS IIb

1. A stand-alone AF surgical ablation procedure may be reasonable for selected patients with highly symptomatic AF not well managed with other approaches *(440)*. *(Level of Evidence: B)*
HRS/EHRA/ECAS Expert Consensus Statement on Catheter and Surgical Ablation of Atrial Fibrillation: Recommendations for Personnel, Policy, Procedures and Follow-Up


Developed in partnership with the European Heart Rhythm Association (EHRA) and the European Cardiac Arrhythmia Society (ECAS); in collaboration with the American College of Cardiology (ACC), American Heart Association (AHA), and the Society of Thoracic Surgeons (STS).

Endorsed and Approved by the governing bodies of the American College of Cardiology, the American Heart Association, the European Cardiac Arrhythmia Society, the European Heart Rhythm Association, the Society of Thoracic Surgeons, and the Heart Rhythm Society.

1. Symptomatic AF patients undergoing other cardiac surgical procedures,
2. Selected asymptomatic AF patients undergoing cardiac surgery in whom the ablation can be performed with minimal risk,
3. Stand-alone AF surgery should be considered for symptomatic AF patients who prefer a surgical approach, have failed one or more attempts at catheter ablation, or are not candidates for catheter ablation.
Quadro 8 – Recomendações para o tratamento cirúrgico da fibrilação atrial.

<table>
<thead>
<tr>
<th>Recomendações</th>
<th>Classe</th>
<th>Nível de Evidência</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacientes com FA sintomática que serão submetidos a cirurgia cardíaca</td>
<td>IIA</td>
<td>B</td>
</tr>
<tr>
<td>Cirurgia para tratamento exclusivo da FA em pacientes com FA sintomática, em quem o tratamento clínico ou a ablação por cateter tenham falhado ou não possam ser realizados</td>
<td>IIB</td>
<td>C</td>
</tr>
<tr>
<td>Pacientes com fibrilação assintomática que serão submetidos a cirurgia cardíaca por outra causa quando possível e com mínimo risco</td>
<td>IIB</td>
<td>C</td>
</tr>
<tr>
<td>Procedimentos híbridos (cirúrgicos epicárdicos e por cateter endocárdicos) podem ser realizados para tratar pacientes com FA persistente ou persistente de longa duração, sintomáticos, refratários a uma ou mais drogas AA das classes I e III, nos quais houve falha na ablação por cateter ou esta não pode ser realizada</td>
<td>IIB</td>
<td>C</td>
</tr>
</tbody>
</table>

FA: fibrilação atrial; AA: antiarrítmicas.
The Society of Thoracic Surgeons 2017 Clinical Practice Guidelines for the Surgical Treatment of Atrial Fibrillation

Vinay Badhwar, MD, J. Scott Rankin, MD, Ralph J. Damiano, Jr, MD, A. Marc Gillinov, MD, Faisal G. Bakaeeen, MD, James R. Edgerton, MD, Jonathan M. Philpott, MD, Patrick M. McCarthy, MD, Steven F. Bolling, MD, Harold G. Roberts, MD, Vinod H. Thourani, MD, Rakesh M. Suri, MD, DPhil, Richard J. Shemin, MD, Scott Firestone, MS, Niv Ad, MD

Division of Cardiothoracic Surgery, West Virginia University, Morgantown, West Virginia (VB, JSR, NA); Division of Cardiothoracic Surgery, Washington University, St. Louis, Missouri (RJD); Division of Thoracic and Cardiovascular Surgery, Cleveland Clinic, Cleveland, Ohio (AMG, FGB, RMS); Department of Cardiothoracic Surgery, Baylor Plano Heart Hospital, Plano, Texas (JRE); Department of Cardiothoracic Surgery, Sentara Heart Hospital, Norfolk, Virginia (JMP); Division of Cardiac Surgery, Northwestern University Feinberg School of Medicine, Chicago, Illinois (PMM); Department of Cardiac Surgery, University of Michigan, Ann Arbor, Michigan (SFB); Department of Cardiovascular Services, Florida Heart and Vascular Care at Aventura, Aventura, Florida (HGR); Division of Cardiothoracic Surgery, Emory University, Atlanta, Georgia (VHT); Division of Cardiothoracic Surgery, University of California Los Angeles David Geffen School of Medicine, Los Angeles, California (RJS); and The Society of Thoracic Surgeons, Chicago, Illinois (SF)
Obs.: No mention to “cut and sew” techniques in this guideline.
Class

I, A - at mitral valve surgery, to restore SR
I, B - at Ao, CABG, Ao+CABG, to restore SR

IIa, B – for lone symptomatic AF refractory to drugs and catheter
IIa, B – Cox-Maze III/IV lesion set is reasonable as compared to PVI alone

III – PVI alone is not recommended in LA>4.5cm or moderate MR

IIa, C – LAA exclusion in conjunction to ablation, for embolism prevention
IIa, C – LAA exclusion in AF patients at time of cardiac surgery

I, C – Multidisciplinary assessment, planning and follow up are beneficial

Ann Thorac Surg 2017; 103: 329-41
Surgical Treatment of Atrial Fibrillation: Current Concepts

- Surgical ablation is effective for SR restoration in all AF forms
- SR restoration improves quality and may prolong life
- SR restoration reduces stroke rate
- Energy sources ablation, when properly used, are effective
- Left atrial and PVI with Cut & Sew is highly effective
- Surgical SR restoration is mandatory in mitral surgery
- Surgical SR restoration might improve outcomes after AVR and CABG
- Moderate or high risk pts with Lone atrial fibrillation refractory to drugs and catheter ablation, should consider surgery
Surgical Treatment of Atrial Fibrillation: Current Concepts

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