Percutaneous Intervention in Valvular Heart Disease: MS & MR

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Worldwide perspective of VHD;

- Epidemiology: Western Vs Developing countries

- Classification, Categorization, Definitions:
  Single, Multi, Mixed, Combined
  Pathophysiology, Mechanisms & Hemodynamics
  Severity: Subjective/Objective

- Approach: Structure/Morphology & Functioning interrelations
  Ventricular function

- Indications Vs Contraindications for Intervention

Therapeutic Aim:

maintaining native valve normal function!
JAMA; 2001 VHD IN WEST COUNTRIES

Incidence

Rheumatic valve disease

Degenerative valve disease

Emerging valve disease

Time

MS
MR, AS
Mitral valve apparatus;

Anatomical Vs Functional Elements

Annulus LA Wall
Leaflets
Chordae Tendinae LV Wall
Papillary Muscles

A valve may function normally and yet be anatomically abnormal!

Beware of anatomical variations!

Keeping Native Structures; Maintaining Function!
**Assessment of Structure & Function of Rh MS:**

**Non Invasive**
- Cardiac Auscultation; The issue of pliability
  - Echocardiography; Morphology & Function
  - The different Scores

**Invasive**
- Fluoroscopy; Calcification
  - Ventriculography: MSDR
  - LA- Pressure Wave Analysis: LAC- Wave

**During PBMC**
- “Balloon impasse “- sign
  - ”Balloon Compression “- sign
The Phenomen of Rheumatic Frozen Post Mitral Leaflet; The Single Wing Door Mechanical Model

Equivalent model

Mitral ring annuloplasty
Different Echocardiographic scores

1. T Wilkins, V Abascal - 1988-MGH
2. C Reid - 1989-USC
3. B Cormier - 1994 - Tenon, & Bichat
4. R Padial - 1996 - MGH-(for MR prediction)
5. D Shaw - 2000-WGH- Ed-UK-(for commissural calcification)
Table 5: Anatomic classification of the mitral valve (Massachusetts General Hospital, Boston): echocardiographic examination

<table>
<thead>
<tr>
<th>Leaflet Mobility</th>
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<tbody>
<tr>
<td>1. Highly mobile valve with restriction of only the leaflet tips</td>
</tr>
<tr>
<td>2. Midportion and base of leaflets have reduced mobility</td>
</tr>
<tr>
<td>3. Valve leaflets move forward in diastole mainly at the base</td>
</tr>
<tr>
<td>4. No or minimal forward movement of the leaflets in diastole</td>
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<table>
<thead>
<tr>
<th>Valvular Thickening</th>
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<tbody>
<tr>
<td>1. Leaflets near normal (4-5mm)</td>
</tr>
<tr>
<td>2. Midleaflet thickening, marked thickening of the margins</td>
</tr>
<tr>
<td>3. Thickening extends through the entire leaflets (5-8 mm)</td>
</tr>
<tr>
<td>4. Marked thickening of all leaflet tissue (&gt;8-10 mm)</td>
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</tbody>
</table>

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<th>Subvalvular Thickening</th>
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<tbody>
<tr>
<td>1. Minimal thickening of chordal structures just below the valve</td>
</tr>
<tr>
<td>2. Thickening of chordae extending up to one third of chordal length</td>
</tr>
<tr>
<td>3. Thickening extending to the distal third of the chordae</td>
</tr>
<tr>
<td>4. Extensive thickening and shortening of all chordae extending down to the papillary muscle</td>
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<th>Valvular Calcification</th>
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<tbody>
<tr>
<td>1. A single area of increased echo brightness</td>
</tr>
<tr>
<td>2. Scattered areas of brightness confined to leaflet margins</td>
</tr>
<tr>
<td>3. Brightness extending into the midportion of leaflets</td>
</tr>
<tr>
<td>4. Extensive brightness through most of the leaflet tissue</td>
</tr>
</tbody>
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Note: The final score is found by adding each of components.
Our daily practice

Commissures

Chordae T.Length

Ant Mitral Leaflet

Table 6: Anatomic classification of the mitral valve

<table>
<thead>
<tr>
<th>Echocardiographic Group</th>
<th>Mitral valve anatomy</th>
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<tbody>
<tr>
<td>Group 1</td>
<td>Pliable noncalcified anterior mitral leaflet and mild subvalvular disease, i.e., thin chordae ≥ 10 mm long</td>
</tr>
<tr>
<td>Group 2</td>
<td>Pliable noncalcified anterior mitral leaflet and severe subvalvular disease, i.e., thickened chordae &lt; 10 mm long</td>
</tr>
<tr>
<td>Group 3</td>
<td>Calcification of mitral valve of any extent, as assessed by fluoroscopy, whatever of subvalvular apparatus</td>
</tr>
</tbody>
</table>

Ventriculography: **MSDR: MV-PM/AV-LVA**

*Short rigid CT: DR < 0.14 (n~0.24)*

*Circ 1960; 60: I-71 CW Akins et al.*
Management of Rheumatic MS:

1. Directed to primary valve pathology: dilatation - PMI
   - Surgery
   Replacement - Mechanical
   - Biological

2. Directed to secondary phenomenae:
   Slowing heart rate, maintaining NSR
   Congestion
   Thromboembolism
   LV dysfunction
   Infections
Technique

Antegrade approach: needs TSLHC
- Balloon Vs Non balloon techniques
- Single Vs Multiple balloons
- Over the wire Vs Non wire guided

Retrograde approach: no need for TSLHC

Criteria for successes: Opt. sub optimal

Complications related to: Vascular access
- TSLHC
- Valvular dilatation
Atrial Septostomy; Static Vs Dynamic – after TSP

Guided by:

Fluoroscopy

Echo: TTE, TEE, IVS

Intracavitary ECG
Simple Operative Procedure:

1. Insert the balloon stretching tube into the balloon catheter to narrow the outer diameter of the balloon.

2. Remove the balloon stretching tube and pull the inner tube.
Antegrade approach – needs TSLHC

OVER THE WIRE
Double Balloon Tech.

Non OVER THE WIRE
Inoue Balloon –SB Tech
Retrograde approach

No need for TSLHC

FIGURE 2. Placement of the guiding catheter (GC) below the mitral valve (MV). A and B, anterior oblique views. LA = left atrium. Other abbreviations as in Figure 1.

FIGURE 3. Introduction of the 0.025-inch guidewire (GW) to the atrial cavity (LA). Right anterior oblique view. Other abbreviations as in Figure 1.
PMI - Mechanical Commissurotomy

Positioning

Dilating
EARLY HEMODYNAMIC RESULTS

POST BMV
PRE BMV
* P<0.05

CO: 4+/-0.8
MdP: 17+/-7
LAP: 9+/-5
PASP: 25+/-6
MVA: 55+/-9

N.S.

CO: 48+/-6
MdP: 0.8+/-0.3
LAP: 1.8+/-0.2

*
Prediction of outcome of PBMC: Multifactorial

- Morphological characteristics of the valve
  -(Commissures, AML-morphology, mobility, CT-length)
- Age, FC, AF, s/p surgery, LA size, PHT, TR, LV-function
- Effective balloon dilating area
- Final MVA
- Experience of the team

Issues to be discuss

Associated MR, LA thrombi, LV function, Associated V.H.D
Non Pharmacologic Therapeutic Modalities in Rheumatic MS;

Consider:

Pts: Age, Fertility period, life expectancy, compliance

AF (Maze procedure)

Needs Vs Risk of Anticoagulation

Associated Valvular Abnormalities, Comorbidities

Valvular Morphology and Function

PHT, LV Function

CI to Surgery Vs PCMI

Complexity & Durability of Therapeutic Approach
Mitral Regurgitation

Classifications:
Primary, Secondary
Based on etiology: Degenerative, Ischemic
Acute, Chronic
Congenital Acquired
Surgical Mitral Valve repair

Successful “corrective” operation: restores longevity and quality of life

The choice of operation depends on etiology, mechanisms, experience of surgeon

Surgical Concepts
- Degenerative MR: Leaflet repair techniques + annuloplasty ring
- FMR: Annuloplasty approaches
- IMR: Coronary revascularization + reduction annuloplasty

Can we mimic it in the Cath Lab? Oh yes we can!
Trans catheter MV Therapies

MV –Leaflet Interventions: Either the Clip or the Stitch techniques
Isolated approach: only in A2 –P2 pathologies
Freedom from Reop. & Rec MR for 12 years :80%

Maisano F. Eurointervention 2006; 2 181-6
MV – Leaflet Interventions: Beware of the Limitations!

Look for:
Leaflet morphology, anatomy & MR jet (only 20% are suitable based on Echo Cr)

A team approach technique

Device: Clip can reposition, removed
2nd clip can be placed

**EVEREST –I**: Feasibility & Safety
Acute procedure success: 73%
30 days MACE: 7%
Hospital stay < 2 days 85%
2 years freedom death, Rec. Surg or Rec MR - 80%

*JACC 2005;462134-40*

**EVEREST –II**: Randomizing Pts
PVI Vs Standard Surgery
Mitral Valve Annuloplasty

MV Annular reduction diameter

The Indirect (CS) & Direct techniques

Indirect: via CS

Monarc Device (Edwards Lifescinces), Carillon (Cardiac Dimension), Viacor
Limitations of the CS approach

- CS doesn’t directly parallel to the mitral annulus
- The issue of the Cx artery
- CS erosion, thrombosis
- CS : A conduit for CRT, Retrograde cardioplegia
Direct Mitral Annuloplasty

The Mitralign Device (Tewksbury, Mass)

Transpericardial Annulus & LV Remodeling

*SLAC: Septal to Lateral Annular Cinching tech.*

Off Pump Approach

Coapsys surgical system (Myocor, Minn)

Applying tension on both MA & basal LV cavity

The Transventricular bridge

iCoapsys: Percutaneous approach

Analogous to the surgical plication tech.

*J Thorac Cardiovasc Surg 1977;73:589-95*
SL enlargement is the final common pathway of FMR or IMR

Miller DC et al. Circ 2001;104:I-47-53

Percutaneous septal-sinus shortening procedure

Effective procedure in ameliorating FMR in ovine tachycardia model. Rogers JH et al

Circ 2006 ;113:2329-34

Transatrial bridge PS³ system

<table>
<thead>
<tr>
<th>Echo Data</th>
<th>SLS mm</th>
<th>MR grade</th>
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<tr>
<td>B</td>
<td>32±5</td>
<td>2.1 ±0.6</td>
</tr>
<tr>
<td>A 30 days</td>
<td>24 ±2</td>
<td>0.4 ±0.1</td>
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1. Less pain, less trauma
2. Less invasive
3. Early recovery
4. Short hospital stay
5. Cheaper procedure

"Real progress is undertaken when we look to the sky but still stand on a solid ground."

Nicolaus Copernicus 1473-1543