Arrhythmic Risk and Aortic Stenosis
Aortic Stenosis: Etiology

- Congenital bicuspid valve is the most common abnormality
- Rheumatic heart disease and degeneration with calcification are found as well
Common Clinical Scenarios

✓ Younger people
  ✓ Functional murmur vs MVP vs bicuspid AV

✓ Older people
  ✓ Aortic sclerosis vs aortic stenosis
Pathophysiology of Aortic Stenosis

- Left ventricular outflow obstruction
  - LV systolic pressure > aortic pressure

- Concentric left ventricular hypertrophy
  - Sustains high LV pressures
  - Normalizes wall stress \( (radius \times pressure/\text{wall thickness}) \)
  - Eventually results in impaired LV diastolic compliance

- LA hypertrophy and enlargement

- Severe stenosis: Limits ability to increase stroke volume on demand

  Critical aortic stenosis = fixed cardiac output
Natural History of Aortic Stenosis

✓ Long asymptomatic “latent” period
✓ “Cardinal” symptoms of severe aortic stenosis
  ✓ Dyspnea
  ✓ Angina
  ✓ Syncope
✓ Sudden death
✓ Left ventricular dilatation and contractile failure
✓ Endocarditis
✓ Arrhythmias
  ✓ Ventricular tachycardia
  ✓ Conduction system disease
  ✓ Atrial fibrillation
Mechanisms of Syncope in Aortic Stenosis

- Fixed cardiac output: Vasodilation (exercise, vagal stimulation, drug induced), inability to augment CO, drop in cerebral perfusion pressure.

- Heart block: Ca^{++} deposits in aortic ring encroach upon conduction tissue

- Ventricular arrhythmias (LVH, ischemia)
Which of these patients is most likely to have syncope?
A 75 year old man has recurrent seizures. Holter ECG monitoring during a seizure.

What is the appropriate management?
Predictors of Risk for MI, HF, Death

✓ Unstable Coronary Syndrome
  ✓ angina, acute or recent MI

✓ Decompensated Heart Failure
  ✓ new onset, worsening HF, NYHA Class IV

✓ Significant Arrhythmias
  ✓ high grade AV block, symptomatic or new ventricular arrhythmia,
  ✓ tachycardia with rate > 100, symptomatic bradycardia

✓ Severe Valvular Disease
  ✓ severe aortic stenosis, symptomatic mitral stenosis
Left Bundle Branch Block
Bifascicular Block
Complete AV Block
Diagnostic Value of ECG

✓ Preexisting conduction disturbance
✓ WPW Syndrome
✓ ECG aspects of genetic syndromes

Oreto G. I Disordini del Ritmo Cardiaco - CSE 1997
Diagnostic criteria with initial evaluation

- Vasovagal syncope is diagnosed if syncope is precipitated by emotional distress or orthostatic stress and is associated with typical prodrome.
- Situational syncope is diagnosed if syncope occurs during or immediately after specific triggers (cough, sneeze, GI stimulation, micturition, post-exercise, post-prandial).
- Orthostatic syncope is diagnosed when it occurs after standing up and there is documentation of orthostatic hypotension.
- Arrhythmia related syncope is diagnosed by ECG when there is:
  - Persistent sinus bradycardia < 40 bpm in awake or repetitive sinoatrial block or sinus pauses > 3 s.
  - Mobitz II 2nd or 3rd degree atrioventricular block.
  - Alternating left and right BBB.
  - VT or rapid paroxysmal SVT.
  - Non-sustained episodes of polymorphic VT and long or short QT interval.
  - Pacemaker or ICD malfunction with cardiac pauses.
- Cardiac ischaemia related syncope is diagnosed when syncope presents with ECG evidence of acute ischaemia with or without myocardial infarction.
- Cardiovascular syncope is diagnosed when syncope presents in patients with prolapsing atrial myxoma, severe aortic stenosis, pulmonary hypertension, pulmonary embolus or acute aortic dissection.
Narrow QRS Tachycardia
Wide QRS Tachycardia
“...le conclusioni più importanti possono dipendere da particolari apparentemente trascurabili....”

Sherlock Holmes

Oreto G. I Disordini del Ritmo Cardiaco - CSE 1997
Valvular disease and Sudden Death

✓ Aortic stenosis (predominate)

✓ The mechanism of sudden death is unclear, and both malignant ventricular arrhythmia and bradyarrhythmia have been documented
Underlying Arrhythmias of SD

- VT: 62%
- Primary VF: 8%
- Bradycardia: 17%
- Torsades de Pointes: 13%

Pathological Progression of CV Disease

Underlying etiology in ~60% of CHF:
- Hypertension
- Cardiomyopathy
- Valvular Disease

Underlying etiology in ~40% of CHF:
- Neurohormonal stimulation
- Endothelial dysfunction
- Myocardial toxicity
- Vasoconstriction
- Renal sodium retention

Symptoms:
- Dyspnea
- Fatigue
- Edema

Death

Coronary artery disease

Low ejection fraction

Pump failure

Chronic heart failure

Arrhythmia

1 Adapted from Cohn JN. N Engl J Med. 1996;335:490-498.
LVEF and SCA Incidence

Risk of Sudden Death: GISSI-2 Trial

Maggioni AP. Circulation. 1993;87:312-322.
Prevalence and Prognosis of Ventricular Dysynchrony

Ventricular dysynchrony impairs diastolic and systolic function 4-6:
- Reduced LV filling time; Increased mitral regurgitation; Depressed dP/dt

3. Iuliano et al. AHJ 2002;143:1085-91

LBBB More Prevalent with Impaired LV Systolic Function
- Preserved LVSF (1) 8%
- Impaired LVSF (1) 24%
- Mod/Sev HF (2) 38%

Increased All-Cause Mortality with Wide QRS at 45 Months (3)
- P < 0.001
- QRS < 120 ms: 34%
- QRS ≥ 120 ms: 49%

## Diagnostic Yield

<table>
<thead>
<tr>
<th>Test</th>
<th>Appropriate</th>
<th>Diagnostic</th>
<th>NND</th>
</tr>
</thead>
<tbody>
<tr>
<td>History and physical exam</td>
<td>308 (100%)</td>
<td>47 (15%)</td>
<td>7</td>
</tr>
<tr>
<td>ECG</td>
<td>241 (78%)</td>
<td>25 (10%)</td>
<td>10</td>
</tr>
<tr>
<td>Holter ECG</td>
<td>82 (27%)</td>
<td>13 (16%)</td>
<td>6</td>
</tr>
<tr>
<td>EPS</td>
<td>51 (17%)</td>
<td>14 (27%)</td>
<td>4</td>
</tr>
</tbody>
</table>

Europace 2002; 4: 351-356
Recommendations
Electrophysiological study (EPS)

- Diagnostic criteria:
  - EPS is diagnostic and no additional tests are required in:
    - Sinus bradycardia and prolonged CSNRT (> 525 ms).
    - BBB and either a baseline HV interval of ≥100 ms, or 2nd or 3rd degree His-Purkinje block.
    - Induction of sustained monomorphic VT in patients with previous MI.
    - Induction of rapid SVT which reproduces hypotensive or spontaneous symptoms.
  - An HV interval between 70 & 100 ms should be considered diagnostic.
  - Induction of polymorphic VT or VF in patients with Brugada syndrome, ARVC & patients resuscitated from cardiac arrest may be considered diagnostic.
  - Induction of polymorphic VT or VF in patients with ischaemic or DCM cannot be considered a diagnostic.
Markers of Arrhythmic Risk

✓ Simple “descriptors”
✓ Prognostic Indicators
✓ Decision-making
Impianto della protesi nel tratto di efflusso del VS dove il meccanismo di auto espansione del nitilolo può interferire con il sistema di conduzione, soprattutto vero nei pazienti anziani che hanno già di base disturbi di Conduzione (BBDx, EASn; BBSn, Blocchi A-V di vario grado)

Dai dati di J. La Borde emerge in modo inequivocabile che un impianto di circa 4-6 mm al di sotto del piano valvolare aortico si associa ad un’incidenza di impianto di pacemaker dal 7% al 15% (Roten L, Windecker S, Hellige G, et al. Eur Heart J 2009;30 (suppl 1):606)
### Complicanze maggiori a 30 giorni del FRANCE Registry (French Aortic National CoreValve and Edwards) (dati presentati al PCR 2010)

<table>
<thead>
<tr>
<th>Complicanze maggiori a 30 giorni del FRANCE Registry (French Aortic National CoreValve and Edwards) (dati presentati al PCR 2010)</th>
<th>TOTALE</th>
<th>Edwards TF (n:95)</th>
<th>CoreValve TF (n:66)</th>
<th>Edwards TF (n:71)</th>
<th>CoreValve SC (n:12)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortalità</td>
<td>31 (12.7%)</td>
<td>8 (8.4%)</td>
<td>10 (15.1%)</td>
<td>12 (16.9%)</td>
<td>1 (8.3%)</td>
<td>0.32</td>
</tr>
<tr>
<td>Tamponamento</td>
<td>5 (2.0%)</td>
<td>2 (2.1%)</td>
<td>2 (3.0%)</td>
<td>-</td>
<td>1 (8.3%)</td>
<td>0.16</td>
</tr>
<tr>
<td>Stroke</td>
<td>9 (3.6%)</td>
<td>4 (4.2%)</td>
<td>3 (4.5%)</td>
<td>2 (2.8%)</td>
<td>-</td>
<td>0.94</td>
</tr>
<tr>
<td>Occlusione coronarica</td>
<td>3 (1.2%)</td>
<td>2*(2.1%)</td>
<td>1 (1.5%)</td>
<td>-</td>
<td>-</td>
<td>0.77</td>
</tr>
<tr>
<td>Nuovo pacemaker</td>
<td>29 (11.8%)</td>
<td>5 (5.3%)</td>
<td>18 (27.2%)</td>
<td>3 (4.2%)</td>
<td>3 (25%)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Complicanze vascolari</td>
<td>16 (6.5%)</td>
<td>5 (5.2%)</td>
<td>5 (7.5%)</td>
<td>5 (7.0%)</td>
<td>1 (8.3%)</td>
<td>0.83</td>
</tr>
<tr>
<td>Infezioni</td>
<td>7 (2.8%)</td>
<td>1 (1.0%)</td>
<td>1 (1.5%)</td>
<td>5 (7.0%)</td>
<td>-</td>
<td>0.15</td>
</tr>
<tr>
<td>Trasfusione≥1 unità sangue</td>
<td>52 (21.3%)</td>
<td>8 (8.4%)</td>
<td>9 (13.6%)</td>
<td>25 (27.4%)</td>
<td>10 (83.3%)</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>
Selection of Pacemaker Systems for Patients With AV Block

AV block

Chronic atrial tachyarrhythmia, reversion to sinus rhythm not anticipated

Desire for AV synchrony

No

Yes

Desire for rate response

No

Yes

Desire for atrial pacing

No

Yes

Rate-responsive dual-chamber pacemaker

Ventricular pacemaker

Single-lead atrial sensing ventricular pacemaker

Rate-responsive ventricular pacemaker

Ventricular pacemaker

Rate-responsive ventricular pacemaker

Dual-chamber pacemaker

Selection of Pacemaker Systems for Patients With Sinus Node Dysfunction

Sinus Node Dysfunction

Evidence for impaired AV conduction or concern over future development of AV block

Desire for AV synchrony

Yes

No

Desire for rate response

Yes

No

Atrial pacemaker

Rate-responsive atrial pacemaker

Ventricular pacemaker

Rate-responsive ventricular pacemaker

Dual-chamber pacemaker

Rate-responsive dual-chamber pacemaker

Desire for rate response

Desire for rate response

Siti di Stimolazione Cardiaca (para-HIS)
Siti di Stimolazione Cardiaca (RVOT)
Preoperative Risk Evaluation
“Prepares the Patient to TAVI”