Armen D. Ristić
(no disclosures related to this presentation)

Imaging pericardial disease: update 2011

INVASIVE DIAGNOSTIC PROCEDURES

Department of Cardiology, Clinical Center of Serbia
Belgrade University, Faculty of Medicine, Belgrade, Serbia
Imaging pericardial disease

INVASIVE PROCEDURES

- Pericardiocentesis
- Pericardioscopy with targeted pericardial and epicardial biopsies
  * Percutaneous
  * Surgical
- Cardiac catheterization to verify constrictive or effusive-constrictive pericarditis
Invasive diagnosis in pericardial diseases

CLINICAL DECISION MAKING STEPS = TREATMENT STRATEGIES & OPTIONS

ETIOLOGY
fluid and/or tissue samples for the analyses

HEMODYNAMIC COMPROMISE
- Size of the effusion
- Accumulation rate

CHRONIC MANIFESTATIONS
- Constriction
  - Severity
  - Extension

<table>
<thead>
<tr>
<th>Pressure</th>
<th>Critical tamponade</th>
<th>Critical tamponade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limit of pericardial stretch</td>
<td>Rapid effusion</td>
<td>Slow effusion</td>
</tr>
</tbody>
</table>
**PERICARDIAL EFFUSION**

- **Symptomatic management**
  - Exercise restriction, hospitalisation only in pts with fever >38°C, subacute onset immunodepression, trauma, oral anticoagulant therapy, and myopericarditis
  - **Pain management/prevention of recurrences**
    - Aspirin 800 mg tid or qid +
    - Colchicine, 1.0–2.0 mg for the 1st day and then 0.5–1.0 mg/d for 3 months

- **PERICARDIOCENTESIS**
  - Subxiphoid pericardiotomy and drainage
  - Pericardial drainage (best with cardiac catheterisation)

- **PERICARDIOSCOPY AND PERICARDIAL/EPICARDIAL BIOPSY**

- **INTRAPERICARDIAL THERAPY**

- **FOLLOW-UP ECHOCARDIOGRAPHY**

**PERICARDIAL EFFUSION**

- TAMPONADE or PE >20 mm in diastole
- Suspected purulent, TBC or neoplastic effusion

- NO TAMPONADE PE 10-20 mm in diastole

- NO TAMPONADE PE <10 mm in diastole

**PERICARDIAL DRAINAGE (best with cardiac catheterisation)**

**TAMPONADE or PE >20 mm in diastole**

**Suspected purulent, TBC or neoplastic effusion**
Drainage of the pericardial effusion

**SELECTION OF THE APPROACH**

- **Pericardiocentesis**
  - ♦ Subxiphoid (medial)
  - ♦ Intercostal (apical)

- **Surgical approach**
  - ♦ Subxiphoid pericardiotomy, VATS
  - ♦ Medial sternotomy and pericardiectomy
# Techniques for pericardiocentesis

## APPROACH, GUIDANCE, DEVICES

<table>
<thead>
<tr>
<th>PERICARDIOCENTESIS</th>
<th>TECHNIQUE</th>
</tr>
</thead>
</table>
| **STATE OF THE ART** | - Echocardiography  
- Fluoroscopy |
| **EMERGING/ALTERNATIVE** | - Halo phenomenon guidance  
- Tuohy needle approach to normal pericardium  
- Simultaneous RV - puncturing needle contrast injections  
- Pacing capture  
- CT-guided pericardiocentesis  
- CT-fluoroscopy  
- Computer-assisted pericardiocentesis |
| **OBSOLETE** | - No guidance ≥ 4% mortality  
- ECG (ST elevation) |
| **APPROACH** | **STANDARD**  
- Subxiphoid  
- Intercostal (apical)  
**EMERGING/ALTERNATIVE**  
- Paracardial  
- Trans-atrial  
- Trans right ventricular  
- Transbronchial  
- Transcardiac |
| **DEVICES** | **STANDARD**  
- 16- or 18-gauge polytet-f-sheathed venous “intracath” needles (Deseret)  
- 17-gauge Tuohy needle  
- Thin-walled 18-gauge needle  
**EMERGING/ALTERNATIVE**  
- PerDUCER® device  
- Peri-attacher  
- Wang endoscopic needle-catheter |
Drainage of the pericardial effusion

SAFETY FIRST!

- Strict aseptic conditions, ECG, and blood pressure monitoring
- Direct ECG monitoring from the puncturing needle is NOT an adequate safeguard.
  - The needle approaches pericardium slowly with a steady manual aspiration
  - Stop when effusion is aspirated.
  - Exchange PROMPTLY for soft J-tip guidewire and after dilatation for a multi-holed pigtail catheter.
Pericardial Access and Drainage

FEASIBILITY AND SAFETY OF BLIND PERICARDIOCENTESIS

(Krikorian, Hancock, Am J Med 1978)

- N = 123 pts
- 93% successful if the effusion was large and of both anterior and posterior location
- 58% feasibility with small and posteriorly located effusions
- Mortality 5/123 pts (4%)
- Nonfatal hemopericardium also 5/123 (4%)

Franz Schuh
1804-1865

The first successful percutaneous pericardiocentesis, 1840 in Vienna
(The first pericardiotomy - Francisco Romero in Barcelona in 1803)
Echocardiographic guidance of pericardiocentesis
MAYO CLINIC APPROACH - RESULTS

(Tsang, ACC 1999, Chest 1999)

- 960 consecutive procedures (779 primary therapeutic)
- Simple PC (Gp 1), PC+ 3.9 days drainage (Gp 2), sclerotherapy (Gp 3)

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedural success</td>
<td>360 (97%)</td>
<td>382 (98%)</td>
<td>18 (100%)</td>
</tr>
<tr>
<td>Death</td>
<td>1 (0.3%)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Major complications</td>
<td>6 (1.6%)</td>
<td>5 (1.3%)</td>
<td>0</td>
</tr>
<tr>
<td>Pericardial surgery</td>
<td>37 (10%)</td>
<td>20 (5%)</td>
<td>0</td>
</tr>
</tbody>
</table>

- **Loculated pericardial effusion after cardiac surgery**: efficacy of 96%, major complications - 2%
Echoguidance of pericardiocentesis

RESCUE PERICARDIOCENTESIS

Rescue echocardiographically guided pericardiocentesis for cardiac perforation complicating catheter-based procedures

- N=88 pts with acute tamponade
- **Success in relieving tamponade 99%**
- The only and definitive therapy in 82%
- No mortality
- **Major complications (3%)**:  
  * pneumothorax (n=1),
  * right ventricular laceration (n=1) and  
  * intercostal vessel injury with RV laceration (n=1)

(Tsang, JACC 1998)
Pericardiocentesis guided by echocardiography

- Bedside, intensive care unit, cardiac cath. lab., or operating theatre.
- Echocardiography should identify the shortest route where the pericardium can be entered intercostally (usually in the sixth or seventh rib space in the anterior axillary line).
- Intercostal arteries should be avoided.
Pericardial Access and Drainage

FLUOROSCOPIC vs. ECHO GUIDANCE
ADVANTAGES AND DISADVANTAGES

- Direct visualization of the procedure in „real-time“
- Hemodynamic assessment (exclusion of effusive-constrictive pericarditis)
- Possibility to proceed with pericardioscopy and pericardial biopsy in the same session
- Better recognition and management of complications
- More costly and time-consuming
PERICARDIOCENTESIS KITS
Approach to the pericardium and pericardiocentesis

HEMODYNAMICS DURING PE DRAINAGE

Intrapericardial pressure (mmHg)

PE 700 ml

PE 300 ml

PE 100 ml

No PE – Drainage completed
Approach to the pericardium and pericardiocentesis

CARDIAC CATHETERIZATION IN DIAGNOSIS OF EFFUSIVE-CONSTRICTIVE PERICARDITIS

Approach to the pericardium and pericardiocentesis

PERICARDIACENTESIS VS. SURGERY

Tsang et al. Am J Cardiol 2003
Fluoroscopic guidance of pericardiocentesis

EPICARDIAL HALO PHENOMENON


📍 **Subepicardial fat as an aid in diagnosis of PE**
(Torrance, Am J Roentgenology 1955)
(Kremens, Radiology 1955)

📍 **Inflammatory changes ?**
📍 **Fibrin deposition ?**
📍 **We have utilized epicardial halo phenomenon to distinguish heart shadow in the lateral view and to tangentially approach the pericardial space.**
**Fluoroscopic guidance of pericardiocentesis**

**EPICARDIAL HALO PHENOMENON**


<table>
<thead>
<tr>
<th>N=92 pts</th>
<th><strong>PA VIEW</strong></th>
<th><strong>LATERAL VIEW</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>84.1%</td>
<td>92.0%</td>
</tr>
<tr>
<td>Specificity</td>
<td>57.2%</td>
<td>44.9%</td>
</tr>
<tr>
<td>Positive predictive value</td>
<td>66.3%</td>
<td>62.5%</td>
</tr>
<tr>
<td>Negative predictive value</td>
<td>78.2%</td>
<td>71.4%</td>
</tr>
<tr>
<td>Likelihood ratio</td>
<td>1.5</td>
<td>1.7</td>
</tr>
</tbody>
</table>
Fluoroscopic guidance of pericardiocentesis

EPICARDIAL HALO PHENOMENON

N=92 pts
Pericardiocentesis using the PerDUCER® system

Pericardiocentesis using the PerDUCER® system

Macris et al. Clin Cardiol 1999

Step 1

Step 2

Step 3

Step 4
Intrapericardial procedures for cardiac regeneration by stem cells

Need for minimal invasive access (AttachLifter) to the normal pericardial cavity
Highly Controlled Vascular Syringes for Pericardiocentesis

Table 1. Loss of needle control with pericardiocentesis syringes.

<table>
<thead>
<tr>
<th></th>
<th>Conventional Syringe (n = 20)</th>
<th>Vascular Syringe (n = 20)</th>
<th>Percent Difference</th>
<th>95% Confidence Interval</th>
<th>Significance p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>20 ml Devices</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unintended forward penetration (mm)</td>
<td>19.1 ± 6.7 mm</td>
<td>9.0 ± 3.4 mm</td>
<td>-53% (10.1 ± 5.5 mm)</td>
<td>-71% to -33%</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Unintended retraction (mm)</td>
<td>5.8 ± 3.5 mm</td>
<td>2.3 ± 1.6 mm</td>
<td>-60% (3.5 ± 2.5 mm)</td>
<td>-90% to -30%</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td><strong>10 ml Devices</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unintended forward penetration (mm)</td>
<td>15.8 ± 4.4 mm</td>
<td>8.8 ± 4.3 mm</td>
<td>-44% (7.0 ± 4.3 mm)</td>
<td>-62% to -27%</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Unintended retraction (mm)</td>
<td>4.8 ± 2.8 mm</td>
<td>2.1 ± 1.6 mm</td>
<td>-56% (2.7 ± 2.2 mm)</td>
<td>-87% to -26%</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

Figure 5. The vascular syringe filling with pericardial fluid. The aspiration plunger is depressed until the vascular syringe is filled with fluid. Once filled, the vascular syringe is then rotated off of the needle, or the needle is rotated off of the vascular syringe, and a wire can be inserted into the needle or a new syringe device attached.
Johannes Volkmann, professor of surgery at the University of Ulm, Germany, was the first to apply rigid endoscopic instruments for pericardiocopy (1957).

Nikolai Petrovich Synitsin, professor of pharmacology from Moscow, who developed the first transthoracic optical system for examination of the heart and pericardium (1955).
Percutaneous Pericardioscopy and Biopsy

FLEXIBLE ENDOSCOPY
Percutaneous Pericardioscopy and Biopsy

RIGID ENDOSCOPY

- Subxiphoid pericardiotomy
- Partial pericardiectomy (window)
- VATS
- Rigid pericardioscopy and pericardiotomy
- Extensive surgical pericardiectomy (>1 yr expected survival)

Manca et al. Surg Endosc 2009

24F Visiport rigid endoscope

Palma et al. Rev Bras Cir Cardiovasc 2009
## Technique vs Characteristic findings

### OBLIGATORY (indication class I)

<table>
<thead>
<tr>
<th>Technique</th>
<th>Characteristic findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auscultation</td>
<td>Pericardial rub (mono-, bi-, or triphasic)</td>
</tr>
</tbody>
</table>
| ECG                        | *Stage I:* anterior and inferior concave ST segment elevation. PR segment deviations opposite to P polarity.  
|                            | *Early stage II:* ST junctions return to the baseline, PR deviated.  
|                            | *Late stage II:* T waves progressively flatten and invert  
|                            | *Stage III:* generalised T wave inversions  
|                            | *Stage IV:* ECG returns to prepericarditis state.                                        |
| Echocardiography           | Effusion types B-D (Horowitz)                                                            |
|                            | Signs of tamponade                                                                       |
| Blood analyses             | a) ESR, CRP, LDH, leukocytes (inflammation markers)                                       |
|                            | b) Troponin I, CK-MB (markers of myocardial lesion)                                       |
| Chest x-ray                | Ranging from normal to “water bottle” heart shadow. Revealing pulmonary/mediastinal pathology. |

### MANDATORY IN TAMponade (indication class I), OPTIONAL IN LARGE/RECURRENT EFFUSIONS OR IF PREVIOUS TESTS INCONCLUSIVE (indication class II) IN SMALL EFFUSIONS (indication class IIb)

<table>
<thead>
<tr>
<th>Technique</th>
<th>Characteristic findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pericardiocentesis and drainage</td>
<td>PCR and histochemistry for aetiopathogenetic classification of infection or neoplasia</td>
</tr>
<tr>
<td>Pericardioscopy, pericardial biopsy</td>
<td>Establishing the specific aetiology</td>
</tr>
<tr>
<td>CT/ MRI</td>
<td>Effusions, peri-, and epicardium</td>
</tr>
</tbody>
</table>

*Maisch, Seferovic, Ristic et al. ESC guidelines, Eur Heart J 2004*
Flexible percutaneous pericardioscopy

METHODOLOGY MODIFICATIONS

- Olympus HYF-1T, 16F and Storz AF110181 flexible endoscopes (biopsy channel 2-2.2 m)
- Active pericardial drainage
- Intrapericardial instillation of 100-300 ml of air
- AIMED BIOPSY
- EXTENSIVE SAMPLING
- Epicardial and pericardial biopsy samples

Maisch, Ristić, Seferović, Tsang, Interventional Pericardiology, Springer 2010
### Flexible percutaneous pericardioscopy

**FEASIBILITY OF PERICARDIAL BIOPSY**

- **Seferovic, Ristic et al. Circulation 2003**

<table>
<thead>
<tr>
<th></th>
<th>Group 1 (12 Patients)</th>
<th>Group 2 (22 Patients)</th>
<th>Group 3 (15 Patients)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Olympus FB-43ST Biopsy Forceps</strong></td>
<td>3–6 Samples</td>
<td>4–6 Samples</td>
<td>Pericardioscopy</td>
</tr>
<tr>
<td>Feasibility of pericardial access, %</td>
<td>92.8</td>
<td>96.2</td>
<td>100</td>
</tr>
<tr>
<td>Feasibility of sheath introduction, %</td>
<td>92.3</td>
<td>96.0</td>
<td>100</td>
</tr>
<tr>
<td>Adequate pericardial visualization, %</td>
<td>NA</td>
<td>90.9</td>
<td>93.3</td>
</tr>
<tr>
<td>Sampling efficiency, %</td>
<td>43.7</td>
<td>84.9*</td>
<td>84.2†</td>
</tr>
<tr>
<td>Total number of pericardial samples</td>
<td>62</td>
<td>129</td>
<td>289</td>
</tr>
<tr>
<td>Mean sample number</td>
<td>5.2±1.0</td>
<td>5.9±0.5</td>
<td>19.3±1.0</td>
</tr>
<tr>
<td>Total number of biopsy attempts</td>
<td>142</td>
<td>152</td>
<td>343</td>
</tr>
<tr>
<td>Mean number of biopsy attempts</td>
<td>11.8±2.1</td>
<td>6.9±0.8</td>
<td>22.9±2.2</td>
</tr>
</tbody>
</table>

*Sampling efficiency indicates successful biopsies per total number of attempts (%).

ANOVA results: F=5.43, P<0.01; *P<0.01 group 2 vs group 1; †P<0.01 group 3 vs group 1.*
Flexible percutaneous pericardioscopy

SAMPLING EFFICIENCY / SENSITIVITY

Seferovic, Ristic et al. Circulation 2003

Group 1 (fluoroscopy, 12 pts, 3-6 samples/pt)
- Sampling efficiency: 43.7%
- Sensitivity: 84.9%

Group 2 (pericardioscopy, 22 pts, 4-6 samples/pt)
- Sampling efficiency: 41.7%
- Sensitivity: 57.9%

Group 3 (pericardioscopy, 15 pts, 18-20 samples/pt)
- Sampling efficiency: 84.2%
- Sensitivity: 93.3%

The results indicate significant differences in sampling efficiency and sensitivity among the three groups, with Group 3 showing the highest values.
DIAGNOSTIC VALUE OF FLEXIBLE PERCUTANOUS PERICARDIOSCOPY

Seferovic, Ristic et al. Circulation 2003

%  

Fluoroscopic biopsy (3-6 samples)  
Pericardioscopy (3-6 samples)  
Pericardioscopy (18-20 samples)  

* *  
* *
### HISTOLOGY OF PERICARDIAL BIOPSIES

**BELGRADE EXPERIENCE**

(Seferovic, Ristic et al. Circulation 2003)

<table>
<thead>
<tr>
<th>Histopathologic Findings</th>
<th>Group 1 (12 Patients) Fluoroscopy 3–6 Samples</th>
<th>Group 2 (22 Patients) Pericardioscopy 4–6 Samples</th>
<th>Group 3 (15 Patients) Pericardioscopy 18–20 Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Squamous-cell carcinoma, %</td>
<td>8.3</td>
<td>13.6</td>
<td>13.3</td>
</tr>
<tr>
<td>Adenocarcinoma, %</td>
<td>0</td>
<td>13.6</td>
<td>6.7</td>
</tr>
<tr>
<td>Mesothelioma, %</td>
<td>0</td>
<td>0</td>
<td>6.7</td>
</tr>
<tr>
<td>Plasmocytoma, %</td>
<td>0</td>
<td>4.5</td>
<td>0</td>
</tr>
<tr>
<td>Hodgkin’s disease, %</td>
<td>0</td>
<td>4.5</td>
<td>6.7</td>
</tr>
<tr>
<td>Tuberculosis, %</td>
<td>0</td>
<td>4.5</td>
<td>20</td>
</tr>
<tr>
<td>Nonspecific inflammation, %</td>
<td>33.3</td>
<td>22.7</td>
<td>40</td>
</tr>
</tbody>
</table>

ANOVA results (group 1 vs group 2 vs group 3): $P > 0.05$
DIAGNOSTIC VALUE OF SURGICAL PERICARDIOSCOPY


- Pericardiocentesis: 54%
- Subxyphoid window biopsy: 71%
- Pericardioscopy & aimed biopsy: 92%

N = 141 pts
Neoplastic Pericarditis

PERICARDIOSCOPY

In 10/44 pts (22.7%) pericardioscopy corrected the false negative PE cytology and pericardial window biopsy (Porte et al. Eur J Cardiothorac Surg 1999)
Neoplastic Pericarditis Pericardial Effusion in Lung Cancer

THE ROLE OF PERICARDIOSCOPY, BIOPSY AND FENESTRATION

- Pericardioscopy with biopsy and creation of a pericardial window in 72 patients who had bronchogenic carcinoma and concomitant pericardial effusion.

- **Diagnostic value:** Metastases were found in 50 of the 72 patients (69.5%).

- Definitive diagnosis and effective palliative treatment are best achieved by biopsy and creation of a pericardial window.

Percutaneous Pericardioscopy and Biopsy

RIGID/SURGICAL ENDOSCOPY

- 91 pts with indeterminate pericardial effusions
- Video-assisted pericardioscopy, 9-year period
- The established diagnosis:
  - nonspecific inflammation - 55%
  - neoplastic disorders - 24.2%
  - tuberculosis - 12.1%
  - bacterial infection - 3.3%
  - chylopericardium - 2.2%
  - fungal infections - 2.2%
  - viral infection - 1.1%
- Video-assisted guided biopsies of the pericardium established the diagnosis in 36.3% of the cases,
- Diagnosis through the fluid analysis observed in 13.2%
- Association of both methods - 45% of the definitive diagnosis in the study.

Abrão FC et al. Arq Bras Cardiol 2010
VIDEO-ASSISTED SURGICAL PERICARDIOSCOPY
Epimyocardial pacemaker leads implantation

Efficacy and feasibility of pericardial endoscopy by a subcutaneous approach

Koichi Nagashima, Ichiro Watanabe*, Yasuo Okumura, Kimie Ohkubo,
Masayoshi Kofune, Toshiyuki Ohya, Yuji Kasamaki, and Atsushi Hirayama

Division of Cardiology, Department of Medicine, Nihon University School of Medicine, 30-1 Oyaguchi-kamicho, Itabashi-ku, Tokyo 173-8610, Japan
Rigid and flexible endoscopes were used for placement of screw-in pacing leads (4-F).
- 17 adult pigs (80 kg)
- Epimyocardial electrodes were implanted through the endoscope onto all four chambers.
- Superior endorsement of rigid endoscopy, due to better orientation and stability, led to its exclusive deployment in the remaining 14 individuals.
- Access to the implantation sites was quick (<10 min).
- Measured pacing parameters were comparable with classic endocardial-derived thresholds.

Diagnostic value of pericardioscopy
ESTABLISHED THERAPEUTIC IMPLICATIONS

1. Autoreactive PE
2. Neoplastic PE
3. Tuberculous PE
4. Epicardial pacemaker lead implantations
5. Guidance of epicardial ablations
Figure 2-3. Three cases of constrictive pericarditis. LEFT IMAGES, Jugular venous distention (fullness in the neck). RIGHT IMAGES, Prominent y descents (concavity in the neck) and right atrial pressure tracings. The mean right atrial pressures are approximately 20 mm Hg in each of the cases. Given the height of the venous column, the y descent is the only waveform that comes into view in the neck. The y descent of the middle case increases with inspiration.

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Constrictive pericarditis

CARDIAC CATHETERIZATION

Hemodynamic changes

- Prominent X and Y descent on right atrial pressure curve
- Diastolic ventricular pressure waveform, "square root" or "dip and plateau" sign
Constrictive pericarditis

KUSSMAUL'S SIGN

Hutchison's Atlas of Pericardial Diseases Saunders 2009
Restrictive cardiomyopathy vs. constrictive pericarditis

CARDIAC CATHETERIZATION

<table>
<thead>
<tr>
<th>RESTRICTIVE CARDIOMYOPATHY</th>
<th>CONSTRICTIVE PERICARDITIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>♦ LVEDP often &gt;5 mmHg greater than RVEDP, but may be identical</td>
<td>♦ RVEDP &amp; LVEDP usually equal</td>
</tr>
<tr>
<td>♦ RVEDP &gt; 1/3 of RV systolic pressure</td>
<td>♦ With inspiration increase in RV systolic pressure, decrease in LV systolic pressure</td>
</tr>
<tr>
<td></td>
<td>♦ RV systolic pressure &lt;50 mmHg</td>
</tr>
<tr>
<td></td>
<td>♦ With expiration, opposite changes</td>
</tr>
</tbody>
</table>

Mukhopadhyay IJC 2006
Equalization of pressures (B) and dip-and-plateau ('square root') sign in right and left ventricular end-diastolic pressures (A)
Restrictive cardiomyopathy vs. constrictive pericarditis

**ENDOMYOCARDIAL BIOPSY**

<table>
<thead>
<tr>
<th>RESTRICTIVE CARDIOMYOPATHY</th>
<th>CONSTRICITIVE PERICARDITIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>May reveal specific cause of restrictive cardiomyopathy</td>
<td>May be normal or show nonspecific myocyte</td>
</tr>
</tbody>
</table>

**Positive pathohistology** = diagnostic *(myocardial restriction)*

**Negative pathohistology** = diagnostic *(pericardial constriction)*
Invasive diagnostic procedures in pericardial diseases

CONCLUSIONS

- Necessary in suspected neoplastic and bacterial pericardial effusion.
- Useful for etiological clarification of recurrent forms resistant to treatment (diagnostic value highly dependent from the availability of the PCR, cardio-immunology).
- Recommended for haemodynamic verification of constriction.
- Risk-benefit and cost-benefit balance should be always kept in mind.