Session: Update on Constrictive Pericarditis

Management Options and Risks

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and Philipps University Marburg
Marburg, Germany

I do not have any potential conflict of interest
Definition of Constrictive Pericarditis

- Constrictive pericarditis is present when a fibrotic, thickened, and adherent pericardium restricts diastolic filling of the heart.
- Initial episode of acute pericarditis
- Subacute stage of organization and resorption of the effusion
- Chronic stage consisting of fibrous scarring and thickening of the pericardium with obliteration of the pericardial space.
- Special form: Effusive constrictive

Maisch et al ESC-Guidelines 2004 Management of Pericardial Diseases
Differential Diagnosis of Constrictive Pericarditis

- Acute heart failure
- Pulmonary emboli
- Right infarction
- Pleural effusion
- COPD
- Restrictive cardiomyopathy

Maisch et al. ESC-Guidelines 2004
Management of Pericardial Diseases
Symptoms & History of Constrictive Pericarditis

Non-specific symptoms

- Fatigue
- Peripheral edema
- Breathlessness
- Abdominal swelling

History

- TBC
- Trauma
- Previous pericarditis
- Systemic disease
- Prior radiation
- Cardiac surgery
- Implanted pacemaker

Pericarditis constrictiva - Clinical Features

78 y patient, m, TBC 1950

- Palpitations (Sinus tachycardia/SVT/TAA..)
- Dyspnoea
- Weakness, muscle wasting
- Hypotension, low pulse pressure
- Jugular venous distension
- Kussmaul sign present: Inspiratory collapse of jugular veins in inspiration, which is absent in tamponade
- Abdominal distension
- Pulsus paradoxus is sign of constriction or tamponade = decrease of pulse amplitude or reduction of arterial pressure) during Inspiration

Maisch et al ESC-Guidelines 2004
Management of Pericardial Diseases
Constrictive Pericarditis in Chest X-Ray and CT

78 y patient, m, TBC 1950

Chest x-ray: Pericarditis calcarea

CT: Calcifications pericarditis calcarea
CT und Cardio MRT in Constrictive Pericarditis

- Thickened and/or calcified pericardium
- Tube-like configuration of one or both ventricles
- Enlargement of one or both atria
- Narrowing of one or both atrio-ventricular grooves
- Congestion of the caval veins

Courtesy of R. Maksimović and T. Dill

Maisch et al ESC-Guidelines 2004
Management of Pericardial Diseases
Echocardiography in Constrictive Pericarditis

78 y Patient, m, TBC 1950

Horowitz et al 1974
Echocardiography in Constrictive Pericarditis

Caveat:
Pericardial thickening does

- not always equal to constrictive physiology

- may also be absent in proven constriction

(18% of 143 surgically proven cases, Talreja et al. Circulation 2003).

Maisch et al ESC-Guidelines 2004
Management of Pericardial Diseases
Transient Forms of Constriction and Effusion

PE Horowitz type C

PE Horowitz type E

Haley et al. J Am Coll Cardiol 2004
Echo-Doppler in Constrictive Pericarditis & Tamponade: „The constrictive pattern“

- Reduced E wave (early mitral filling) during inspiration and
- Reduced diastolic flow in pulmonary veins also during inspiration
- The opposite in expiration
- Increase of the reverse hepatic venous flow in diastole
- No inspiratory collapse in the lower vena cava

Note: Echo-Doppler phenomena in tamponade are identical to those in constrictive pericarditis

Doppler – Echocardiography in tamponade is based on the dissociation of the intracardiac and intrathoracic pressures. The interventricular interdependence increases with diastolic filling.

78 y patient, m, TBC 1950
Heart Catheterisation in Constrictive Pericarditis

78 y patient, m, TBC 1950

Myers and Spodick. Am Heart J 1999

- “Dip und plateau” or “square route sign” in den RV and/or LV pressure curves
- enddiastolic pressure equalisation in RV & LV ()..
- In occult constriction infusion of 1-2 l normal saline disguises constriction

Maisch et al ESC-Guidelines 2004 Management of Pericardial Diseases
Management Options and Risks: Improved Diagnosis by Pericardioscopy and Biopsies

78 y patient, m, TBC 1950
TBC PERICARDITIS

78 y patient, m, TBC 1950

Pericardioscopy

Histology - caseous necrosis

Intraop. Histology

Multinucleated giant cell

Immunohistochemistry
Pericardioscopy with Epi- and Pericardial Biopsy

Seferovic et al, Circulation 2003;107:978-983
Etiology of Pericardial Effusion

N= 290 patients, 186 male, Age 56.5±14.9 years
Marburg 1989-2011

- Viral PE 13.5%
- Autoreactive PE 12.6%
- Malignant PE 42.8%
- Lymphocytic PE 9.8%
- PE in Borreliosis 2.3%
- TBC PE 3.7%
- Bacterial PE 3.3%
- Postoperative 11.2%
- Radiogenic 0.9%

Maisch et al 2011
Etiology of Constrictive Pericarditis

Cleveland Clinic 1977-2000 (n=150)
Bertog et al 2001

- Idiopathic: 62 (41%)
- Postsurgical: 54 (36%)
- Radiation: 20 (13%)
- Miscellaneous: 14 (9%)

Marburg Heart Center 1989-2011 (n=15)
Maisch et al 2011

- Idiopathic: 7 (46%)
- TBC: 2 (13.5%)
- Radiation: 2 (13.5%)
- Postsurgical: 3 (20%)
- Neoplastic: 1 (7%)

Cleveland Clinic

Marburg Heart Center
Viral etiology of constrictive pericarditis is extremely rare but possible!

Brignoli 48j,

Parvo B19 Positive konstriktive Perikarditis

Initial diagnosis: idiopathic pericarditis, But no microbial diagnosis done. Treatment With corticoids for several months, Surgery for constriction. Tissue analysis: Parvo B19

Courtesy A. Brucato
Radiogenic Pericarditis with Constriction

occurs in Mamma CA, Hodgkin/NHL, Oesophagus CA

Incidence depends on radiated pericardial surface, dosage and radiation technique

- 0.4% of 831 women with breast cancer (Pierce et al. Int J Radiat Oncol Biol Phys 23; 915, 1992)
- 15% of patients mit esophagus cancer (Cwikiel et al. Acta Oncol 33; 49: 1994)

- Constriction can occur after years!
If symptomatic for >2 years

CLINICAL SUSPICION FOR

- CHRONIC PERICARDIAL EFFUSION
- CONSTRUCTIVE PERICARDITIS
- EFFUSIVE-CONSTRUCTIVE PERICARDITIS
- RECURRENT PERICARDITIS

ECHOCARDIOGRAPHY

CARDIAC CATHETERIZATION

Symptomatic management
Hospitalisation and exercise restriction
Pain management
- Ibuprofen, 300-800 mg tid or qid
- Colchicine, 0.5 mg bid
- Prednisone 1-1.5 mg qd

Congestive heart failure therapy

Maisch et al ESC-Guidelines 2004
Management of Pericardial Diseases
MRI and CT in Preoperative Risk Assessment for Pericardiectomy

- Exclusion of patients with extensive myocardial fibrosis and/or atrophy significantly reduces the mortality rate.

Maisch et al ESC-Guidelines 2004
Management of Pericardial Diseases
Effusive-Constrictive Pericarditis

• Tense pericardial effusion in the presence of visceral pericardial constriction.

• May represent a stage in the development of classic constrictive pericarditis.

• After pericardiocentesis, there is a persistent elevation and equilibration of right atrial, RV, and LV diastolic pressures.
Loculised Effusion with Partial Constriction of Right Atrium
Loculised **Inferior** Effusion with Partial Constriction

Pericardial effusion

Minimal effusion type B to C1
Loculised **Lateral** Effusion with LA Compression
Loculised **Anterior** Effusion with RV Compression

![Ultrasound Image with Loculated Pericardial Effusion]
CONSTRUCTIVE PERICARDITIS

Who should be treated?

• Presence of increasing JVP
• Need for diuretic therapy
• Evidence of hepatic insufficiency
• Reduced exercise tolerance
CONSTRICITIVE PERICARDITIS

Who should NOT be treated?

• Very early constriction (occult and functional class I)
• Transitory constriction
• Severe, advanced disease (functional Class IV) (operative mortality 30-40% vs. 6-19%)*

*Hoit, Circulation 2002
When is surgery indicated?

- If surgery is carried out early, long-term survival after pericardiectomy corresponds to that of the general population (Ling et al. Circulation 1999).
- If severe clinical symptoms were present for a longer period before surgery, even a complete pericardiectomy may not achieve a total restitution (Seni et al., JACC 1999).
Surgery should
Aim for complete pericardiectomy
Avoid patients with myocardial fibrosis or atrophy or radiation
A certain etiology
## Constrictive Pericarditis

### Predictors of Surgical Outcome

<table>
<thead>
<tr>
<th>Outcome</th>
<th>No. of Events</th>
<th>Adjusted Hazard Ratio</th>
<th>95% CI</th>
<th>P</th>
</tr>
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<tbody>
<tr>
<td><strong>Overall survival</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Age</td>
<td>39</td>
<td>1.07</td>
<td>1.04–1.10</td>
<td>&lt;0.0001</td>
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<tr>
<td>NYHA class</td>
<td>2.43</td>
<td>1.22–4.86</td>
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<tr>
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<td>Serum sodium</td>
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<td>1.04–1.18</td>
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<tr>
<td><strong>Late survival</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Age</td>
<td>26</td>
<td>1.08</td>
<td>1.04–1.12</td>
<td>&lt;0.0001</td>
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<tr>
<td>NYHA class</td>
<td>3.99</td>
<td>1.76–9.08</td>
<td>0.0009</td>
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<tr>
<td>Previous radiation</td>
<td>11.80</td>
<td>4.57–30.44</td>
<td>&lt;0.0001</td>
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<tr>
<td><strong>Late CV death</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>17</td>
<td>1.07</td>
<td>1.03–1.12</td>
<td>0.0009</td>
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<tr>
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<td>1.25–9.19</td>
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<td>6.77–63.52</td>
<td>&lt;0.0001</td>
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<td><strong>Late NYHA class III–IV CHF</strong></td>
<td>30</td>
<td></td>
<td></td>
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<tr>
<td>Age</td>
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<td>1.04</td>
<td>1.01–1.07</td>
<td>0.010</td>
</tr>
<tr>
<td>Previous radiation</td>
<td>9.47</td>
<td>4.19–21.39</td>
<td>&lt;0.0001</td>
<td></td>
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<tr>
<td>Ascites</td>
<td>2.19</td>
<td>1.03–4.67</td>
<td>0.042</td>
<td></td>
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</table>

CV indicates cardiovascular; CHF, congestive heart failure.

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Ling et al.  
Circulation 1999
CONSTRICITIVE PERICARDITIS

Predictors of surgical outcome - Risk of Irradiation

Ling et al. Circulation 1999
DIFFERENTIATION BETWEEN CONSTRICITION AND RESTRICTION
Differentiation of Constriction and Restriction

<table>
<thead>
<tr>
<th></th>
<th>NORMAL</th>
<th>RESTRICTIVE CM</th>
<th>CONstrictive pericarditis</th>
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<tbody>
<tr>
<td><strong>ECG / Respiration</strong></td>
<td><img src="image1" alt="Waveform" /></td>
<td><img src="image2" alt="Waveform" /></td>
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<tr>
<td><strong>Mitral Inflow</strong></td>
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<tr>
<td><strong>Tricuspid Inflow</strong></td>
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<td><img src="image8" alt="Waveform" /></td>
<td><img src="image9" alt="Waveform" /></td>
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<tr>
<td><strong>Pulmonary Vein Flow</strong></td>
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<td><img src="image11" alt="Waveform" /></td>
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<tr>
<td><strong>Hepatic Vein Flow</strong></td>
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<td><img src="image14" alt="Waveform" /></td>
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<td><strong>Doppler Tissue Imaging</strong></td>
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<td><img src="image18" alt="Waveform" /></td>
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<tr>
<td><strong>Color M-Mode</strong></td>
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<td><img src="image20" alt="Image" /></td>
<td><img src="image21" alt="Image" /></td>
</tr>
</tbody>
</table>

(Hoit, Circulation 2002, Rajagopalan et al. AJC 2001)
Differentiation of Restriction from Constriction by Echocardiography

LV Wall thickness and motion
Restriction          Constriction
Etiologic Classification of Restrictive Cardiomyopathy


• **Myocardial**
  – Noninfiltrative (IDC, HCM, Diabetic CM...)
  – Infiltrative (Amyloidosis, Sarcoidosis...)
  – Storage diseases (Hemochromatosis, Fabry’s disease...)

• **Endomyocardial**
  – Endomyocardial fibrosis
  – Hypereosinophilic syndrome, etc.
DD: Amyloidosis

- Congo red x400
- HE x400
- Immunohistochemistry for Lambda light chains x400
Constrictive pericarditis is rare

Diagnostic difficulties lie in the clinical differentiation of COPD and RCM and the patients after radiation therapy, who may have both constrictive pericarditis and myocardial fibrosis.

Combination of imaging methods (Echo, MRI, CT, x-ray) with pericardioscopically guided epicardial and endomyocardial biopsy may help in decision making for surgery. Because

The risk of surgery is highly increased in patients with ventricular atrophy, myocardial fibrosis and post irradiation.

In surgery complete pericardiectomy should be done. Triple A-Rule

In effusive – constrictive pericarditis combined medical and intrapericardial treatment can be successful.
International Symposium on Inflammatory Heart Disease
Marburg, 20.-21. September 2012
and Abschiedsvorlesung
Prof. Dr. Bernhard Maisch
21. September 2012
Alte Aula

Live Course on Pericardioscopy and Epimyocardial Biopsy
on September 20, 2012
(Activity of the ESC working group on Myocardial and Pericardial Disease)

Location:
University Hospital of Internal Medicine & Cardiology, UKGM GmbH
Baldingerstr. (Klinikum Lahnberge), Marburg, HS II with Videotransmission

Bus transportation from the Hotel Vila Vita Rosenpark to the Hospital will be provided at 13:30 h

Course Directors: Prof. Dr. Bernhard Maisch, Prof. Dr. Arsen Ristic

Time
14.00 Welcome: Bernhard Maisch, Arsen Ristic
14.05 Pericardioscopy — Live-case 1
Patient presentation: Konstantinos Karatolios
Malignant Pericardial effusion
Pericardioscopy: Bernhard Maisch, Michael Schoppet
15.00 Laboratory Examination at cardioimmunology and pathology laboratory Sabine Pankuweit & staff
15.45 Coffee Break
16.00 Pericardioscopy — Case 2 (video demonstration)
Patient presentation: Anette Richter
“Idiopathic” Pericardial effusion
Pericardioscopy: Bernhard Maisch, Arsen Ristic

Session on Pericarditis
Chairs: Massimo Imazio, Arsen Ristic
17.00 Jae Oh Transient pericardial effusion
17.15 Heinz Rupp New Devices to enter the pericardium:
17.30 Massimo Imazio Yehuda Adler Medical treatment
17.45 Konstantinos Karatolios Intrapericardial treatment
18.00 Andre Keren Restrictive cardiomyopathy vs constrictive pericarditis
18.15 Arsen Ristic Scientific statement of the ESC working-group on cardiac tamponade
18.30 Discussion Panel: Future Trends in Pericardial intervention
Yehuda Adler, Massimo Imazio, Bernhard Maisch, Jae Oh, Arsen Ristic, Heinz Rupp, Peter Seferovic
18.40 Task force Meeting of the ESC-Working group on Myocardial and Pericardial Diseases
19.45 Bus transportation to Hotel Vila Vita Rosenpark
20.00 Get together-Marburger Esszimmer, 35033 Marburg, Anneliese Pohl Allee (close to Vila Vita Rosenpark, 150m)
Thank you!
20 y m Pat. Adult Still`s Disease, Pericarditis: Initial Study
Schäufele T et al Clin Res Cardiol 2009

SSFP/cine sequence, diastolic 4 Ch view
SSFP/cine sequence, systolic 4 Ch view

Myocardial callosity
Myocardial callosity

4 Ch view with Gadolinium late enhancement
Short axis view. Gadolinium late enhancement

Pericardial effusion and pericardial delayed enhancement
Myocardial callosity

SSFP/cine sequence, diastolic 4 Ch view

SSFP/cine sequence, systolic 4 Ch view

Myocardial callosity

4 Ch view with Gadolinium late enhancement

Pericardial delayed enhancement

4 Ch view with Gadolinium late enhancement
Constrictive Pericarditis

Clinical presentation

- Severe chronic systemic venous congestion
- Jugular venous distension
- Hypotension
- Low pulse pressure
- Abdominal distension
- Oedema
- Muscle wasting

Courtesy of P. Cocco and G. Thiene

Maisch et al ESC-Guidelines 2004
Management of Pericardial Diseases
Normal Values

**Figure 5-7.** Schematic diagram of quantitative measurements that can be made from the Doppler left ventricular filling curve.

- **IVRT =** isovolumetric relaxation time: $179 \pm 11$ ms
- **E/A-ratio:** $1,9 \pm 0,6$
- **DT =** Deceleration time: $179 \pm 20$ ms
Doppler Echocardiography in Constrictive Pericarditis

- Restricted filling of both ventricles with respiratory variation >25% over the AV-valves).
  - In mixed constriction-restriction and increased atrial pressures respiratory changes are <25%.
  - In atrial fibrillation flow velocity pattern is inconclusive, but hepatic diastolic vein flow reversal in expirium is observed.
- Provocation test with head-up tilting or sitting position with decrease of preload may unmask the constrictive pericarditis.

Maisch et al ESC-Guidelines 2004
Management of Pericardial Diseases
Tissue Doppler Differentiation of Constrictive Pericarditis and RCM

Peak early velocity of longitudinal expansion (peak $E_a$) of $\geq 8.0$ cm/s differentiated pts with constriction from restriction with 89% sensitivity and 100% specificity.

(Rajagopalan et al. Am J Cardiol 2001)
# How to differentiates Constriction from Restriction?

<table>
<thead>
<tr>
<th></th>
<th>Constriction</th>
<th>Restriction</th>
</tr>
</thead>
<tbody>
<tr>
<td>invasive filling pressures</td>
<td>elevated</td>
<td>elevated</td>
</tr>
<tr>
<td>dip and plateau-phenomenon</td>
<td>yes</td>
<td>possible</td>
</tr>
<tr>
<td>diast. pressures identical</td>
<td>yes</td>
<td>no, LV &gt; RV (≥ 5mmHg)</td>
</tr>
<tr>
<td>systol. PA-pressure &gt; 60 mmHg</td>
<td>yes (often)</td>
<td>no</td>
</tr>
<tr>
<td>Kussmaul sign</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Endomyocardial biopsy</td>
<td>non specific</td>
<td>specific for diagnosis</td>
</tr>
</tbody>
</table>

## Echo
- biatrial dilatation: yes
- LV wall thickness: normal or ↓ (atrophy)
- pericard. thickness > 3 mm: yes
- abrupt. End of dors.-mot.LVPW: yes
- restrictive filling pattern: yes
- E/A above 2,0: yes
- DT << 150 ms: yes
- LVEF: normal
- respir. variation of AV-V flow: little

## Clinical
- right heart failure: yes
- venous jugular distension: yes
- Kussmaul sign: yes
- forward failure: yes
- pericardial rubs: (yes)