Διάγνωση και θεραπεία σε παραβαλβιδική ανεπάρκεια

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Introduction

- Echocardiography is more difficult to perform on prosthetic valves compared to native valves
- Many prosthetic valves have a trace or mild amount of transprosthetic regurgitation by design
- **It is important to differentiate between ”physiologic” regurgitation and ”pathologic” regurgitation**
- Ultrasound does not penetrate through some prosthetic valve components
- TEE is a powerful diagnostic choice for evaluating prosthetic valve function and diagnosing dysfunction.
Transcatheter PVL Closure – Safe, Feasible and Efficient treatment

Conflicting data on whether mild-to-moderate PVL affects prognosis and should be addressed in an asymptomatic patient
PVL closure – When don’t close!

- Large defect > 25% with rocking unstable valve
- Prosthetic dysfunction
- Local infection
- Recent surgery < 6 weeks
Percutaneous management of paravalvular leaks

Joel P. Giblett¹,², Bushra S. Rana¹, Leonard M. Shapiro¹ and Patrick A. Calvert¹,²

- Paravalvular leak (PVL) is an important complication of valve replacement surgery and is associated with substantial morbidity and mortality.
- Evidence is emerging for the important role of percutaneous transcatheter closure as the first-line treatment for patients with PVL.
- The role of imaging, particularly fluoroscopy and 3D transoesophageal echocardiography, is important in the assessment, planning and treatment of PVLs.
- A structural heart team approach (with all relevant specialists) is critical for good clinical decision making for patients with PVLs.
Box 1 How to diagnose a PVL in the general cardiology clinic

Clinically significant paravalvular leak (PVL) occurs in approximately 1–5% of all implanted valves and will, therefore, be encountered in the general cardiology clinic. A high index of suspicion is needed in patients presenting with symptoms of heart failure or unexplained anaemia after valve replacement.

Patient history
A detailed history is important, particularly given that some patients will be asymptomatic or will experience only mild symptoms.

Physical examination
Patients might have an abnormal murmur, signs of anaemia, heart failure or stigmata of endocarditis.

Laboratory work-up
The work-up should include investigation of anaemia with a full blood count and blood film to look for increased numbers of reticulocytes and red cell fragments, as well as changes in serum levels of haptoglobin and lactate dehydrogenase. Biomarkers such as B-type natriuretic peptide (BNP) or N-terminal pro-BNP might be useful in the work-up and monitoring of some patients. If clinically indicated, serial blood cultures and measurement of infectious markers, including white cell count and C-reactive protein levels, might be needed to exclude endocarditis.

Imaging
Transoesophageal echocardiography, the initial investigation in the general cardiology clinic, should establish the presence of PVL. 3D transoesophageal echocardiography (TEE) is usually required to assess the extent and severity of the leak and to facilitate procedural planning and device sizing.

Referral
Patients found to have a PVL should be referred to a specialist structural heart team consisting of interventional cardiologists, cardiovascular imaging specialists and cardiothoracic surgeons. Patients might be referred before TEE when clinical suspicion is high.
Characteristics and longer-term outcomes of paravalvular leak after aortic and mitral valve surgery

Shailee Shah, MD, Alaa Alashi, MD, Gosta B. Pettersson, MD, PhD, L. Leonardo Rodriguez, MD, A. Marc Gillinov, MD, Richard A. Grimm, MD, Jose Navia, MD, Samir R. Kapadia, MD, Lars G. Svensson, MD, PhD, Brian P. Griffin, MD, and Milind Y. Desai, MD

In a study of 495 patients, we demonstrate that patients who develop mild PVL or greater following aortic/mitral valve surgery have a high rate of longer-term mortality, despite excellent perioperative outcomes. Greater STS score, right ventricular systolic pressure, infectious etiology and mitral (vs aortic valve) involvement were all independently associated with long-term mortality whereas surgery for PVL closure was associated with improved longer-term survival.
Blue: Conservative therapy
Green: Reoperative cardiac surgery
Generalized Wilcoxon statistic $P = .04$
# Paravalvular Leak

An Interesting Interplay of Acquired vWF-Disease and Late Bleeding After TAVR

Roxana Mehran, MD, Sabato Sorrentino, MD, PhD, Bimmer E. Claessen, MD, PhD

## TABLE 1
Sample of Registries With U.S. FDA-Approved New-Generation TAVR Devices

<table>
<thead>
<tr>
<th>Study (Ref. #)</th>
<th>Population</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOURCE 3 Registry (2,17)</td>
<td>Valve type: balloon-expandable</td>
<td>30-day m/s-PVL: 3.1%</td>
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<tr>
<td></td>
<td>Study design: prospective single-arm multicenter; n = 1,947</td>
<td>30-Day LTB: 5.0%</td>
</tr>
<tr>
<td></td>
<td>Baseline risk: LESA: 18.3 ± 13.2</td>
<td>1-yr all-cause death: 12.6%</td>
</tr>
</tbody>
</table>

| Kodali et al. (18) | Valve type: balloon-expandable | 30-day m/s-PVL: 3.4% (combined cohort) |
| | Study design: prospective single-arm multicenter | 30-day LTB/disabling bleeding: |
| HR/inoperable: n = 583 | HR/inoperable: 10.2% | |
| IR: n = 1,078 | IR: 4.6% | |
| Baseline risk: | 30-day all-cause death | |
| HR/inoperable: STS: 8.7 ± 3.7 | HR/inoperable: 2.2% | |
| IR: STS: 5.3 ± 1.3 | IR: 1.1% | |

| UK & Ireland Evolut R Implanters' Registry (3) | Valve type: self-expandable | 30-day m/s-PVL: 7.7% |
| | Study design: prospective single-arm multicenter; n = 264 | 30-day all-cause death: 2.3% |
| | Baseline risk: STS: 6.0 ± 5.6 | |

| FORWARD Registry (1) | Valve type: self-expandable | Discharge-m/s-PVL: 2.0% |
| | Study design: prospective single-arm multicenter; n = 1,038 | 30-day LTB/disabling bleeding: 3.3% |
| | Baseline risk: STS: 5.5 ± 4.5 | 30-day all-cause death: 1.9% |
Use of a Repositionable and Fully Retrievable Aortic Valve in Routine Clinical Practice

The RESPOND Study and RESPOND Extension Cohort

Nicolas M. Van Mieghem, MD, PhD, Jochen Wührle, MD, David Hildick-Smith, MD, Sabine Bleiziffer, MD, Daniel J. Blackman, MD, Mohamed Abdel-Wahab, MD, Ulrich Gerckens, MD, Axel Linke, MD, PhD, Hitsejin Ince, MD, PhD, Peter Wenzeser, MD, Dominic J. Allocco, MD, Iain T. Meredith, AM, MBBS, PhD, Volkmar Falk, MD

FIGURE 5 Aortic Valve Regurgitation

A RESPOND main cohort

B RESPOND Extension cohort

- Aortic Regurgitation
- Paravalvular Regurgitation

Percentage of Evaluable Echocardiograms

Baseline (N=927) Discharge (N=914) 1 Year (N=551)

Baseline (N=45) Discharge (N=37)
Permanent pacemaker implantation and paravalvular leak rates following sutureless aortic valve operations

Mohamad Lazkani MD\textsuperscript{4*} | Charan Yerasi MD\textsuperscript{2} | Sheena Prakash MD\textsuperscript{3} | Ashish Pershad MD\textsuperscript{3} | Kenith Fang MD\textsuperscript{3}


**FIGURE 1** Different sutureless aortic valve platforms: the Sorin Perceval valve (A); the Medtronic 3f-Enable valve (B); and the Edwards Intuity Valve (C)
General cardiology clinic

- Heart failure symptoms
- Abnormal murmur
- Haemolytic anaemia
  - TTE
  - PVL not seen but high clinical suspicion or mild PVL on TTE

Mild PVL
- Monitor in general clinic
  - Diagnosis of PVL
    - 3D TEE
    - Haemolysis screen
    - Blood cultures

Structural heart team

- Moderate or severe PVL
  - Refer to structural heart team
    - Consider adjunctive imaging (CT or MRI)

- Active endocarditis, gross valve instability (rocking or dehiscence) or concomitant cardiac surgery
  - Surgical repair or replacement

- Indication for percutaneous closure
  - Symptomatic
  - Asymptomatic
    - Evidence of LV decompensation
    - Normal LV function

Follow-up in specialist valve clinic

- TEE-guided percutaneous closure
- Careful monitoring in specialist valve clinic
Η απεικόνιση της παραβαλβιδικής ανεπάρκειας σε σχέση με παρακείμενες δομές

Anatomical Orifice Area (ARO)
Effective Orifice Area (ERO)
Aortic PVL
Multiple mitral paravalvular leaks

Technical aspects of image acquisition

Device Selection - Multiplug Devices AVPIII vs Single Device PLD
Importance of channel measurement in choosing the right PVL closure device
Different theory for PLD devices (undersizing) vs. AVP devices (oversizing)
• **Significant hemolysis** (a rate of 1.6%) is more frequent in:
  * calcified defect
  * mitral location of PVL

• **TPVLC more effectively reduces hemolytic anemia if >90% reduction of PVL VC CSA is achieved.**

• Incomplete TPVLC even if reducing HF symptoms may result in exacerbation of hemolytic anemia.

• In majority of **multiple plugs strategy** is necessary for complete sealing. In some cases when needed replacing the suspect PLD device with a pair of **softer AVP3 devices** (better chance of fixing the haemolysis).

• The deployment of multiple “smaller devices” rather than one or two “larger devices” has a **better sealing** within the PVL and **less interference** with the prosthesis discs.
Ασθενής 75 ετών με ηπια δυσφορία. Προσθετική στην θέση της μιτροειδούς από 7 ετίας
Λαθενής 49 ετών με ιστορικό 3 χειρουργικών επεμβάσεων στην μιτροειδή βαλβίδα και προ έτους
dιαχορυφαία επεμβατική εμφύτευση 3 συσκευών
Προσέρχεται με έκδηλη αιμόλυση (16% ΔΕΚ)
3D έγχρωμο Doppler
Ασθενής 78 ετών με δυσφορία στην κόπωση και αιμόλυση προσερχεται προγραμματισμένα για διακαθετηριακή επεμβατική σύγκλειση παραβαλβιδικής ανεπάρκειας
X-PLANE: Paravalvular leak
X-PLANE
Paravalvular leak
Paravalvular leak – TEE 135
3D ZOOM with color

3D ZOOM with tissue “hide”
3D tending and puncture of atrial septum
…..something wrong
Implantation of the device
Pre and Post implantation
Continuous Doppler
<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Calvert et al.</th>
<th>Garcia et al.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Countries</td>
<td>Ireland and UK</td>
<td>Spain</td>
</tr>
<tr>
<td>Number of centres</td>
<td>20</td>
<td>19</td>
</tr>
<tr>
<td>Number of patients</td>
<td>259</td>
<td>469</td>
</tr>
<tr>
<td>Age (years)</td>
<td>67 ± 13</td>
<td>65 ± 10</td>
</tr>
<tr>
<td>Female (%)</td>
<td>28</td>
<td>47</td>
</tr>
<tr>
<td>Time from implantation to repair (years)</td>
<td>4.7 (1.4–8.9)</td>
<td>8.5 ± 7.8</td>
</tr>
<tr>
<td>Type of PVL (%)</td>
<td>Mitral: 44</td>
<td>Mitral: 70.2</td>
</tr>
<tr>
<td></td>
<td>Aortic: 48</td>
<td>Aortic: 29.8</td>
</tr>
<tr>
<td></td>
<td>TAVR: 5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other: 3</td>
<td></td>
</tr>
<tr>
<td>Follow-up (days)</td>
<td>110 (7–452)</td>
<td>30</td>
</tr>
<tr>
<td>Closure device (%)</td>
<td>AVP3: 62.5</td>
<td>AVP3: 87</td>
</tr>
<tr>
<td></td>
<td>PLD: 3.9</td>
<td>Other: 13</td>
</tr>
<tr>
<td>Technical success (%)</td>
<td>91.0</td>
<td>86.6</td>
</tr>
<tr>
<td>Severe preprocedural leak (%)</td>
<td>61.0</td>
<td>NA</td>
</tr>
<tr>
<td>Severe postprocedural leak (%)</td>
<td>6.7</td>
<td>NA</td>
</tr>
<tr>
<td>Preprocedural NYHA III–IV (%)</td>
<td>66.9</td>
<td>81.8</td>
</tr>
<tr>
<td>Postprocedural NYHA III–IV (%)</td>
<td>10.8</td>
<td>NA</td>
</tr>
<tr>
<td>Overall mortality (%)</td>
<td>3.9 (in-hospital)</td>
<td>4.5 (30 days)</td>
</tr>
</tbody>
</table>

AVP3, Amplatzer Vascular Plug III (Abbott Vascular); NA, not available; PLD, Paravalvular Leak Device (Occlutech); PVL, paravalvular leak; TAVR, transcatheter aortic valve replacement.
<table>
<thead>
<tr>
<th>Study (year)</th>
<th>Country</th>
<th>Period</th>
<th>Type of study</th>
<th>Number of patients</th>
<th>End point</th>
<th>Results</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angulo-Llanos et al. (2016)</td>
<td>Spain</td>
<td>2008–2014</td>
<td>Single-centre, retrospective, propensity score-matched analysis</td>
<td>51</td>
<td>36</td>
<td>Composite of death or readmission (mean follow-up 784 days)</td>
<td>No significant difference in composite end point; reduced in-hospital mortality with percutaneous approach</td>
</tr>
<tr>
<td>Finheiro et al. (2016)</td>
<td>Brazil</td>
<td>2011–2013</td>
<td>Single-centre, retrospective analysis</td>
<td>10</td>
<td>25</td>
<td>Reintervention or death at 1 year</td>
<td>No significant difference between groups for either end point</td>
</tr>
<tr>
<td>Wells et al. (2017)</td>
<td>USA</td>
<td>2007–2016</td>
<td>Single-centre, retrospective analysis</td>
<td>56</td>
<td>58</td>
<td>Composite of death, reintervention or heart failure admission at 1 year</td>
<td>No difference in primary end point or 1-year survival between groups</td>
</tr>
<tr>
<td>Taramasso et al. (2014)</td>
<td>Italy</td>
<td>2000–2013</td>
<td>Single-centre, retrospective analysis</td>
<td>17</td>
<td>122</td>
<td>In-hospital death</td>
<td>Risk of death increased with surgical treatment (OR 8.0, 95% CI 1.8–13.0; P = 0.05)</td>
</tr>
<tr>
<td>Millan et al. (2017)</td>
<td>Canada</td>
<td>1994–2014</td>
<td>Single-centre, retrospective, propensity score-matched analysis</td>
<td>80</td>
<td>151</td>
<td>Composite of all-cause death and hospitalization for heart failure (median follow-up 3.5 years)</td>
<td>Reduced risk of end point with surgical treatment (HR 0.28, 95% CI 0.18–0.44; P &lt; 0.001)</td>
</tr>
<tr>
<td>Alkhouri et al. (2017)</td>
<td>USA</td>
<td>1995–2015</td>
<td>Single-centre, retrospective analysis</td>
<td>195</td>
<td>186</td>
<td>Technical success and long-term survival (mean follow-up 4 years)</td>
<td>Technical success greater in the surgical group; no significant difference in long-term survival between groups</td>
</tr>
</tbody>
</table>
Fusion of fluoroscopic and 3D transesophageal echocardiography during closure of a PVL

**Conclusions**

PVL is a common complication of surgical valve replacement, with substantial morbidity and mortality. Although sparse, data indicate that percutaneous closure of PVL is a safe and effective alternative to surgical closure, with similar long-term morbidity and mortality. Although large-scale, randomized data are needed to define the safety and efficacy of percutaneous closure of PVL, the procedure has become the first-line treatment in clinical practice in experienced centres. The procedure is intricate and requires the involvement of an experienced structural heart team to optimize the likelihood of success.