Intramural Hematoma and Penetrating Ulcers
Natural History and Indications for Treatment

D. Böckler
Department of Vascular and Endovascular Surgery
University Hospital Heidelberg
Disclosure

Speaker name:
Dittmar Böckler

I have the following potential conflicts of interest to report:

☑ Consulting
☐ Employment in industry
☐ Stockholder of a healthcare company
☐ Owner of a healthcare company
☐ Other(s)
☐ I do not have any potential conflict of interest
IMH & PAU are complex entities within the “Acute Aortic Syndrome”

Ref.: Ueda et al. Insights Imaging 2012
Does natural course of IMH & PAU implicate invasive treatment - and if, how?
Definition of IMH

- First described by Krukenberg 1920
- **Collection of blood confined to aortic media**
- **No dissecting membrane**, absence of false lumen and no mechanism of decompression by reentry tear
- **Spontaneous rupture of aortic vasa vasorum** due to microscopic tears in the aortic intima
- **PAU** as a origin of IMH

Definition of PAU

- Focal atherosclerotic lesion disrupting the internal elastic lamina
- Progressive erosion of atheroma mural plaque
- Confined to intimal layer, not associated with IMH
- Mostly asymptomatic
- > 90% located in descending thoracic aorta
- Often multiple locations
- Size ranging from 2-25 diam., 4-30 mm depth

### US -Guidelines

#### Entity/Subgroup

<table>
<thead>
<tr>
<th>Classification</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td>C</td>
</tr>
<tr>
<td>IIa</td>
<td>C</td>
</tr>
<tr>
<td>IIa</td>
<td>B</td>
</tr>
</tbody>
</table>

#### Penetrating ulcer/intramural hematoma

- Asymptomatic
- Symptomatic

#### Acute traumatic

- Ischemia
- No ischemia

#### Subacute dissection

- >5.5 cm, comorbidity
- >5.5 cm, no comorbidity
- <5.5 cm

#### Chronic dissection

- >5.5 cm, comorbidity
- >5.5 cm, no comorbidity
- <5.5 cm

#### Degenerative descending

- Reasonable open risk
- Severe comorbidity
- Thoracoabdominal/severe comorbidity

---

1 Hiratzka et al, Circulation 2010
### Editor’s Choice — Management of Descending Thoracic Aorta Diseases

**Clinical Practice Guidelines of the European Society for Vascular Surgery (ESVS)**

**Writing Committee**

**Document Reviewers**

**Keywords:** Clinical practice, Descending thoracic aorta, Descending thoracic aortic management, Guideline, Recommendations, Thoracic aorta abnormalities, Thoracic aorta diseases, Thoracic aorta disorders, Thoraco-abdominal aorta

### Evidence

<table>
<thead>
<tr>
<th>Evidence Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW</td>
<td>Evidence</td>
</tr>
</tbody>
</table>

Riamabau V et al., EJVES 2017, Jan
Natural History of IMH

- Reabsorption: 40%
- Aneurysm formation: 50%
- Dissection: 10% Type B
- 88% Type A³

Hiratzka Fl et al, Circulation 2010;6
Natural History of PAU

- Formation of pseudoaneurysm: 26%
- Progression to classic dissection: ?
- Rupture: 40%

Coady MA et al, JVS 1998:27:1006-1016,
Bischoff M, Böckler D et al, Cardiovascular Diseases 2011,
Rupture Risk of IMH & PAU: Unknown

But keep in mind: fragile wall conditions with uncertain faith
Indicators of IMH Progression

＞ Patient Selection

- Involvement of the ascending aorta
- Maximum aortic diameter (≥50 mm) on initial diagnostic imaging
- Severe pericardial effusion
- Huge or progressively increasing pleural effusion
- Progressive aortic dilatation at follow-up
- Persistent pain or haemodynamic instability, or both
- Increment of the aortic wall thickness
- Large intimal erosion

Ref.: Villacosta I et al., Heart 2009; 95:1130-39
IMH - Predictors of Mortality

- Location (ascending >> descending aorta)
- Maximum aortic diameter > 40 mm
  (30 fold increased risk for aneurysm or rupture)
- Thickness of IMH > 10 mm  (9 fold increased risk)
- Recurrent pain
- Pleural effusion & periaortic bleeding?
Definition of complicated IMH

• Rupture or impending rupture
• Radiographic findings: severely bulging hematoma, subadventitial spread, extra-adventitial blood
• Progression of hematoma or overall aortic size with repeated imaging, aortic dilatation >5 cm
• Malperfusion

1 Coady et al, Circulation 2010, 29:2780-2804
Survival of IMH & PAU patients

P 0.03

IMH 65.8%

Coady, Cardiol Clinics 1999
Significant predictors for disease progression:
- sustained pain
- increasing pleural effusion
- maximum diameter
- maximum depth

Ganaha et al., Circulation 2002:106:342
Published Heidelberg Experience with IMH & PAU

Early and midterm results after endovascular stent graft repair of penetrating aortic ulcerations

Philipp Greisitsch, MD,*, Drossos Kotellas, MD,*, Tim F. Weber, MD,*, Alexander Hybliek Dürr, MD,*, Hans-Ulrich Kauczor, MD, PhD,† and Dittmar Böckler, MD, PhD,‡, Heidelberg, Germany

Purpose: To present early and midterm results after endovascular stent graft repair of penetrating aortic ulcerations (PAU).

Methods: Between January 1997 and March 2008, a total of 202 patients received thoracic endovascular aortic stent grafts in our institution, 48 patients (32 men, median age 70 years, range, 48-89) with PAU. A retrospective analysis of these patients was performed. Thirty-one patients (65%) showed an acute aortic syndrome (8 contained rupture, 23 symptomatic). Follow-up scheme included postoperative computed tomography angiography prior to discharge, at 3, 6, and 12 months, and yearly thereafter. Mean follow-up was 33.3 months (1.3-112.6).

Results: Technical success was achieved in 93.2%. Primary clinical success rate was 81.2%. In-hospital mortality was 14.6%. Perioperative mortality was significantly (P = .036) higher in patients with acute aortic syndrome compared to asymptomatic patients (22.5% vs 0%). Postoperative complications occurred in 15 patients (31%), including 2 patients with minor strokes and 6, respectively, 5 patients with cardiac and/or respiratory complications. Early endoleaks were observed in 9 patients (19%), late endoleaks in another 2 patients. Retention was necessary in 4 of 48 patients (8.4%). The actuarial survival estimates at 1, 3, and 5 years were 78% ± 5%, 74% ± 7%, and 61% ± 10%, respectively. There was no aortic-related death during follow-up. Cox regression showed age (hazard ratio [HR]: 1.08; P = .036) and a maximum aortic diameter >50 mm (HR: 4.92; P = .021) as independent predictors of death.

Conclusion: Endovascular treatment of penetrating aortic ulcerations is associated with a relevant mortality and morbidity rate and thus requires careful planning. Midterm results could prove a sustained treatment success regarding actual in freedom from asymptomatic patients. Midterm results could prove a sustained treatment success regarding actual in freedom from survival and aortic-related deaths. Emergencies show a significantly worse outcome, but patients are still warranted in these symptomatic patients. (J Vasc Surg 2008.)

Treatment indications for and outcome of endovascular repair of type B intramural aortic hematoma

Moritz S. Bischoff, MD,*, Katrin Meinenbacher, MD,† Michael Wehrmeister, MD,*, Dittmar Böckler, MD,*, and Drossos Kotellas, MD,†, Heidelberg and Aschen, Germany

ABSTRACT

Objective: The aim of this study was to analyze the outcome of thoracic endovascular aortic repair (TEVAR) and medical therapy in patients with aortic intramural hematoma type B (IMH).

Methods: Between January 2004 and January 2014, 41 IMH patients were treated 29 underwent TEVAR (16 male median age 69 years, group I) plus best medical therapy (BMT), whereas 13 had BMT alone (6 male median age 69 years, group II). Study endpoints were assessment of indications for TEVAR and BMT, clinical outcome, and evaluation of aortic morphology over time. Median follow-up was 32 months for group I and 40 months for group II.

Results: In group I, TEVAR was immediately performed in 7 of 28 cases because of pain and imaging results (penetrating aortic ulcers, n = 4; intramural blood pools, n = 3). In 21 of 28 cases, TEVAR was undertaken because of clinical or radiologic signs of progression at a median of 10 days (range: 2-233 days). The median number of stent grafts implanted was 1 (range: 1-3). The median length of covered aorta was 15 mm (range: 6.5-35.8 mm). Technical success was achieved in 25 of 28. In-hospital mortality was 1 of 28 in group I and 0 of 18 in group II. Survival in group I was 88.9%, 87.7%, and 67% at 1, 2, and 4 years. There was no death in group II during follow-up. Aortic reinterventions were performed in 6 of 28 group I cases, including 2 open conversions for retrograde type A dissection. Aortic diameter increased during follow-up in 10% in group I and 0% in group II. P = .039). In group I, complete remodeling was seen in 7 of 27 regresses in the remaining 20. In group II, complete remodeling was seen in 3 of 12 regresses in 5 of 12. No patient in group II required invasive treatment.

Conclusions: IMH is justified in uncomplicated IMH. However, IMH becomes complicated in the majority of patients within 20 days. TEVAR in complicated IMH is feasible but associated with a substantial aortic reintervention rate reflecting technical challenges and fragile aortic wall conditions (J Vasc Surg 2016.)
Mortality after TEVAR for PAU

1 - year 76% ± 6%,
3 - years 72% ± 7%
5 - years 61% ± 10%

- No significant difference in asympt. vs. sympt. patients (p=0.46)
- No aortic related death during follow-up

## Risk factor analysis

<table>
<thead>
<tr>
<th>Parameter</th>
<th>HR</th>
<th>95% CI</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1.08</td>
<td>1.00 - 1.18</td>
<td>p=0.036</td>
</tr>
<tr>
<td>Gender</td>
<td>1.05</td>
<td>0.35 - 3.13</td>
<td>p=0.925</td>
</tr>
<tr>
<td>Aortic diameter &gt;50mm</td>
<td>4.92</td>
<td>1.28 - 18.92</td>
<td>p=0.021</td>
</tr>
<tr>
<td>Additional aortic pathology</td>
<td>0.32</td>
<td>0.071 - 1.43</td>
<td>p=0.138</td>
</tr>
</tbody>
</table>

Indications for TEVAR in IMH

- Single center experience
- 2004-2014
- 468 TEVAR – Procedures
- 41 IMH – Type B
- 28 Pat. > TEVAR

Indications for TEVAR in IMH

- Bilateral pleural effusion: 3/7 (42.9%)
- IMH + blood pooling: 3/7 (42.9%)
- IMH + PAU: 4/7 (57.1%)

7/28 (25%): TEVAR without further imaging
Indications for TEVAR in IMH

Fig 3. Indications leading to thoracic endovascular aortic repair (TEVAR; multiple selections possible). Upper figure: Initial TEVAR. Lower figure: Cases crossing over to TEVAR during surveillance. IMH, intramural hematoma; IMHT, IMH thickness; MAD, maximum aortic diameter; PAU, penetrating aortic ulcer; RR, hypertension; progr., progressive; ULP, ulcerlike projection.
Technical Tips for TEVAR in IMH & PAU

- No comparative studies of devices
- Personal opinion: conformability is a key!
Technical Tips for TEVAR in IMH & PAU

Concept of Endolining
Technical Tips for TEVAR in IMH & PAU

Alternative Concept Spot Stent Grafting
Technical Tips for TEVAR in IMH & PAU

- ECG gated CT-Angio for IMH Diagnosis
- Sizing on dedicated workstations
- Oversizing in IMH < 10% and in PAU 20%

Centerline Analysis of Aortic CT Angiographic Examinations: Benefits and Limitations

Summary

- Natural history and TEVAR is based on evidence level C
- According to guidelines: BMT / Conservative Tx indicated
- **BUT**, progression to rupture and mortality occur in up to 30-50%
- Adverse course, if IMH and PAU is combined
- Predictors of progression are known
- Selected candidates can therefore be identified
- Elective TEVAR in selective patients is very satisfactory
- Longterm results for survival are missing
- Treatment in experienced centers is warranted
Intramural Hematoma and Penetrating Ulcers
Natural History and Indications for Treatment

D. Böckler
Department of Vascular and Endovascular Surgery
University Hospital Heidelberg