Aortendissektion
Was sind Warnhinweise?
Wie sieht die Therapie prähospital und insbesondere intrahospital aus?

Martin Misfeld

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Direktor: Prof. Dr. Friedrich W. Mohr
“...the pericardium was found distended with a quantity of coagulated blood, nearly a pint...; the whole heart was so compressed as to prevent any blood contained in the veins from being forced into the auricles; therefore the ventricles were found absolutely void of blood...; and in the trunk of the aorta we found on a transverse fissure its inner side, about an inch and a half long, through which some blood had recently passed under its external coat and formed an elevated ecchymosis.”
John Ritter

Prinzessin Diana

Dr. Michael Ellis DeBakey
Aortendissektion

Inzidenz:
~ 2000 / y in den USA
-- 400-500 / y in Deutschland

Lokalisation des Einrisses:
- Aorta ascendens  65%
- Aorta descendens  20%
- Aortenbogen     10%
- Aorta abdominalis 5%
- kein entry     3-13%
Klassifikationen

**Stanford**
Typ A = Aorta asc. +/- desc.
Typ B = nur Aorta desc.

**DeBakey**
Typ I = Aorta asc. + desc.
Typ II = nur Aorta asc.
Typ III = nur Aorta desc.
IIIa = bis Diaphragma
IIIb = unterhalb Diaphr.
„Entry“
„Reentry“
„Sonderformen“

PAU
penetrating atherosclerotic ulcer

IMH
intramural hematoma
### TABLE 1. RISK FACTORS FOR ACUTE TYPE A DISSECTION

**Vascular trauma**

**Intrinsic**
- Hypertension
- Atherosclerosis
- Intramural hematoma/Penetrating aortic ulcer
- Excess hemodynamic stress (e.g., pregnancy, cocaine abuse)

**Extrinsic (Iatrogenic)**
- **Antegrade**
  - Coronary catheterization/Angioplasty
  - Aortic cannulation for cardiopulmonary bypass (CPB)
  - Aortic cross-clamp
  - Coronary artery bypass graft proximal anastomosis
  - Antegrade needle vent site
  - Aortic valve replacement
  - Transapical aortic valve replacement

- **Retrograde**
  - Femoral cannulation for CPB
  - Transfemoral thoracic stent grafting
  - Transfemoral aortic valve replacement

**Substrate Deficiency**

**Connective tissue disorders**
- Marfan Syndrome
- Ehlers-Danlos Syndrome
- Loeys-Dietz Syndrome
- Turner Syndrome

**Aortopathy**
- Bicuspid aortic valve
- Unicuspid aortic valve
- Thoracic aortic aneurysm
Patienten

- Bekanntes Aortenaneurysma
- KHK
- arterieller Hypertonus
- familiäre Häufung
- Bindegewebsanomalien
- Aortenklappenfehler (bikuspide AK)
Abraham Lincoln
12.2.1809 – 15.4.1865
Marfan Syndrom

Ehlers-Danlos Syndrom
Loeys-Dietz Syndrom
Marfan Syndrom

- autosomal-dominant vererbte Bindegewebskrankung
- Fibrillin-1 (FBN1) Abnormalität
- Inzidenz: 1/5.000 to 1/10.000
- 25% spontane Mutationen
- Verschiedene Organsysteme sind betroffen: z.B. kardiovaskuläres System, Skelettsystem, Augenlinse, Dura
Marfan Syndrom
- kardiovaskuläre Beteiligung -

- Aorta (Aortenwurzel > Aorta ascendens > Aorta descendens)
- Aortenklappe (Insuffizienz)
- Mitralklappe (Prolaps)
Dilatation der Aortenwurzel
Intraoperatives Bild
Symptome

- plötzlich einsetzender Vernichtungsschmerz
- typisch zwischen den Schulterblättern
- IRAD (=International Registry of acute Aortic Dissection)

85 % „schlimmste Schmerz“
73 % thorakaler Schmerz
64% „eher scharf / spitz“ als „reißend“

- Zeichen der Malperfusion

>>>>>> „daran denken“
Spontaner Verlauf

- Risiko ist abhängig vom Aortendurchmesser
- Akutmortalität: 40%
- 1-2 % / h in der Folgezeit

>>> chirurgischer Notfall!
Maßnahmen

- RR-Kontrolle (β-Blocker)
- Verlegung in ein herzchirurgisches Zentrum
Diagnostik

- Echo
- CT / MRT
- Herzkatheter
Aortendissektion Typ A
Aortendissektion Typ A
Aortendissektion Typ A

Gantry: 0°
FOV: 386 mm
Zeit: 1000 ms
Schicht: 4 mm
Pos.: -137.2
HFS

01.03.2011, 18:57:43
Aortendissektion Typ A
Aortendissektion Typ A
Aortendissektion Typ A
Dr. Michael DeBakey 1960
Aortenwurzelaaneurysma
Aortenwurzelaneurysma mit akuter Typ A Dissektion
Operationsstrategien

I. Behandlung der Aortenwurzel
- suprakommissuraler Aortenersatz
- Aortenklappenrekonstruktion
- Aortenklappenersatz

II. Behandlung des Aortenbogens
- Rekonstruktion der Wandschichten
- partieller Bogenersatz
- Aortenbogenersatz +/- „elefant trunk“
  +/- Ersatz der supraaortalen Äste
CT nach Typ A Dissektion mit OP und Aortenstenting
Resektion der Aortenwurzel
Bentall-Operation
Bentall-Operation

SJM® Masters HP™ Valved Graft
with Gelweave Valsalva™ Technology

SJM® Masters Valved Graft
with Hemashield® Technology
Aortalenklappenprothesen
AK-erhaltender Aortenwurzelersatz: Anatomische Komponenten der Aortenwurzel

- sinotubulärer Übergang
- Sinus von Valsalvae
- Taschenklappen
- Annulus
Klappenerhaltender Ersatz der Aorta ascendens

David-Operation „reimplantation“

Yacoub-Operation „remodeling“
Präparation der Aortenwurzel
Aortic Valve Sparing - Operation “remodelling-technique”

Yacoub-Operation
Yacoub-Operation
Aortic Valve Sparing- Operation “reimplantation-technique”

David TE, Feindel CM.
Reimplantations-Operation (David I)

David TE, Feindel CM. J Thorac Cardiovasc Surg 1992;103:617
David-Operation
Aortenklappenfunktion

native AK

Yacoub-OP

David-OP
In vitro hydrodynamics, cusp-bending deformation, and root distensibility for different types of aortic valve-sparing operations: Remodeling, sinus prosthesis, and reimplantation

Armin Erasmi, MD, Hans-H. Sievers, MD, Michael Scharfschwerdt, Thorsten Eckel, and Martin Mifsud, MD, PhD

Objective: Preserving aortic valve cusps during operations for aortic root pathology theoretically offers several advantages over alternative prosthetic valve-sparing techniques.

Figure 1. Schematic drawings of the different valve-sparing techniques. Left to right: remodeling, modified remodeling, sinus prosthesis, modified sinus prosthesis, reimplantation, and modified reimplantation.

The aortic root is composed of 3 cusps inserted into the aortic wall by 3 crown-shaped fibrous rings that confine the sinuses of Valsalva downstream and the intervalvular trigones upstream. The commissures, as the top of the adjoining fibrous rings, border the sinotubular junction, whereas the so-called aortic annulus, which represents the transition area between the left ventricle and the aorta, includes the nodules of the sinuses, the muscular and the membranous septum, and the aortomital curtain. All of these functional structures perform very sophisticated cyclic movements, interacting with each other. Their dynamic characteristics are aimed at reducing stress on the cusps and optimizing ventricular-arterial coupling to warrant hemodynamic efficiency without structural deterioration of the cusps throughout life. Anomalous and dissections involving the aortic root lead to morphologic, geometric, and hemodynamic abnormalities that often leave the cusps macroscopically intact. Valve-sparing surgical techniques have been developed.
Gefäßprothesen
Aortic Valve Preservation in Patients With Aortic Root Aneurysm: Results of the Reimplantation Technique

Tirone E. David, MD, Christopher M. Feindel, MD, Gary D. Webb, MD, Jack M. Colman, MD, Susan Armstrong, MSc, and Manjula Maganti, MSc

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Background. A study was conducted to determine the long-term results of aortic valve reimplantation to treat aortic root aneurysm.

Methods. Prospective follow-up with clinical assessments and echocardiography was done of 167 consecutive patients who had reimplantation of the aortic valve as treatment of aortic root aneurysm. Their mean age was 45 ± 15 years, 78% were men, 38% had Marfan syndrome, 14% had aortic dissection, and 7% had bicuspid aortic valve. The aortic valve was reimplanted into a straight Dacron (Dupont, Wilmington, DE) tube in 89 patients and in a Dacron tube with creation of neoaortic sinuses in 78. Aortic cusp repair was performed in 66 patients, and the free margin was reinforced with a fine Gore-Tex suture (W.L. Gore & Assoc, Flagstaff, AZ) in 36. The mean follow-up was 5.1 ± 3.8 years and was 100% complete.

Results. There were two operative and six late deaths. Survival at 10 years was 92% ± 3%. Moderate aortic insufficiency developed in 3 patients, and severe developed in 2. Freedom from moderate or severe aortic insufficiency was 94% ± 4% at 10 years. Two patients required aortic valve replacement. Freedom from aortic valve replacement was 95% ± 4% at 10 years. At the latest follow-up, 90% of the patients were in New York Heart Association functional class I and 10% were in class II.

Conclusions. Reimplantation of the aortic valve to treat patients with aortic root aneurysm is associated with excellent long-term survival and low rates of valve-related complications. Reimplantation of the aortic valve is a durable type of aortic valve repair.

Langzeitdaten

92 ± 3% Überleben nach 10 y

1 Schlaganfall, keine Endokarditis
91% in NYHA class I, 7% in NYHA class II in F/U

Langzeitdaten

94 ± 4% nach 10 y

2 Patienten wurden nachoperiert

Long-term results of aortic valve– sparing operations in patients with Marfan syndrome

Tirone E. David, MD, Sue Armstrong, BSc, Manjula Maganti, BSc, Jack Colman, MD, and Timothy J. Bradley, MBChB

Objective: The appropriateness of aortic valve–sparing operations in patients with Marfan syndrome has been questioned. This study examines the long-term results of these operations in patients with Marfan syndrome.

Methods: From 1988 to 2006, 103 consecutive patients with Marfan syndrome (mean age, 37 ± 12 years) and aortic root aneurysm had aortic valve–sparing operations. Emergency surgery was performed in 11 patients: 8 for acute type A aortic dissection and 3 for unexplained persistent chest pain. Fourteen patients also had mitral valve surgery. The technique of aortic valve reimplantation was used in 77 patients, and aortic root remodeling was used in 26 patients. Patients were followed prospectively and underwent annual echocardiographic studies. The mean follow-up was 7.3 ± 4.2 years and 100% complete.

Results: There was 1 operative death and 5 late deaths. Four of the 6 deaths were due to complications of aortic dissections. The patients’ survival at 15 years was 87.2% compared with 95.6% for the general population of Ontario matched for age and sex. Seven patients had important aortic insufficiency: 4 mild to moderate, 2 moderate, and 1 moderate to severe. Freedom from greater than mild aortic insufficiency at 15 years was 79.2%. Three patients, all after aortic root remodeling, had aortic valve replacement, 2 for aortic insufficiency and 1 for endocarditis. At the most recent follow-up, 97 patients were alive: 86 were in functional class I, and 11 were in functional class II.

Conclusions: Aortic valve–sparing operations provided excellent clinical outcomes in this series of patients with Marfan syndrome. Postoperatively, complications of aortic dissections were the leading cause of death.
Langzeitdaten

David TE et al J Thoracic Cardiovasc Surg 2009;138:859
Freiheit von Re-Operation an der Aortenwurzel

- 5 yr - 100%
- 10 yr - 94.9 ± 3.5%
- 15 yr - 87.6 ± 7.7%

David TE et al J Thoracic Cardiovasc Surg 2009;138:859
Remodeling or Reimplantation for Valve-Sparing Aortic Root Surgery?

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Clinic of Cardiac Surgery, University Clinic of Schleswig-Holstein, Campus Luebeck, Luebeck, Germany

Background. Valve-sparing operations are gaining increasing acceptance; however, there is an ongoing discussion about the technique-specific indications. We present our experience with a follow-up of 123 months.

Methods. Between July 1993 and July 2005, 164 consecutive patients were operated on using the remodeling (group A, n = 96) or reimplantation technique (group B, n = 68). Fifty-seven patients presented with acute type A dissection. Aortic regurgitation was present in 84%. Follow-up was 54.7 ± 28 in group A and 48.4 ± 37.3 months in group B.

Results. After urgent operations, 4 patients died in each group, but none died after elective surgery. Late mortality was 8% in group A and 4% in group B. Seven patients of group A and 1 in group B required reoperation. Echocardiographic follow-up of reoperation-free survivors showed that 3 patients (all group A, 1.3%) had aortic regurgitation of more than grade II. Root diameter, valve pressure gradient, and valve orifice area were comparable. No gross thromboembolic or bleeding events occurred.

Conclusions. Aortic valve-sparing operations can provide acceptable long-term results in both techniques. Particular care to the annulus in the remodeling technique and different prosthesis designs in the reimplantation technique may overcome the intrinsic problems of each procedure.

Freiheit von Reoperation

Log-rank test (Cox-Mantel) p=0.145

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>At risk</th>
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</thead>
<tbody>
<tr>
<td>96 Remodeling</td>
<td>49</td>
<td>21</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>68 Reimplantation</td>
<td>23</td>
<td>9</td>
<td>9</td>
<td>8</td>
<td>2</td>
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Factors associated with the development of aortic valve regurgitation over time after two different techniques of valve-sparing aortic root surgery

Thorsten Hanke, MD,a,* Efstratios I. Charitos, MD,a,* Ulrich Stierle, MD,a,* Derek Robinson, MA, MSc, DPhil, CStat,b Armin Gorski, MD,a Hans H. Sievers, MD,a and Martin Misfeld, MD, PhDa

Objective: Early results after aortic valve-sparing root reconstruction are excellent. Longer-term follow-up, especially with regard to aortic valve function, is required for further judgment of these techniques.

Methods: Between July of 1993 and September of 2006, 108 consecutive patients (mean age 53.0 ± 15.8 years) underwent the Yacoub operation (group Y) and 83 patients underwent the David operation (group D). Innovative multilevel hierarchic modeling methods were used to analyze aortic regurgitation over time.

Results: In general, aortic regurgitation increased with time in both groups. Factors associated with the development of a significant increase in aortic regurgitation were Marfan syndrome, concomitant cusp intervention, and preoperative aortic annulus dimension. In Marfan syndrome, the initial aortic regurgitation was higher in group Y versus group D (0.56 aortic regurgitation vs 0.29 aortic regurgitation, P = .049), whereas the mean annual progression rate of aortic regurgitation was marginally higher in group Y (0.132 aortic regurgitation vs 0.075 aortic regurgitation, P = .1). Concomitant cusp intervention was associated with a significant aortic regurgitation increase in both groups (P < .0001). There was a trend that smaller preoperative aortic annulus diameters in group D and larger diameters in group Y were associated with increased aortic regurgitation over time.

Conclusion: In regard to aortic regurgitation grade over time, patients with Marfan syndrome and a large preoperative aortic annulus diameter were better treated with the reimplantation technique, whereas those with a smaller diameter were better treated with the remodeling technique. Concomitant free-edge plication of prolapsing cusps was disadvantageous in both groups. Considering these factors may serve to improve the aortic valve longevity after valve-sparing aortic root surgery.
Yacoub
Aortic Annulus Diameter and Aortic Regurgitation

David-OP: Herzzentrum Leipzig Ergebnisse

- 2006 – 2009: n = 93 (David I oder David V)
- perioperative Letalität: 2.2%
  - Typ A Dissektion: 2/18 = 11%
  - andere Patienten: 0/75 = 0%
- AI (Entlassungsecho):
  - none-to-mild AI -- 98%
  - mild-to-moderate AI -- 2%
Was passiert mit der Aorta descendens nach OP einer Typ A Dissektion?

- 80% der Patienten haben ein persistierendes falsches Lumen

Pat. müssen jährlich mit MRT oder CT nachuntersucht werden!

- Dilatation:
  - 17 % mit kontrolliertem arteriellen Hypertonus
  - 45 % mit *unkontrolliertem* arteriellen Hypertonus

Miller et al. PCR 2000
Aortendissektion Typ B

I. konservativ / medikamentöös

II. Operation

III. Aortenstenting
Aortendissektion Typ B
Chirurgie der chronischen Typ B Dissektion

- Hohe Morbidität
- Mortalität 10%, Paraplegie 10%
- Empfohlen für Aortendurchmesser > 5.5 (5.0?) cm
Aortenpathologie und Chirurgie

- Therapie der Wahl ist der prophylaktische Ersatz der Aorta

- OP empfohlen bei einem Durchmesser > 5.0 cm (4.5 cm?) für die Aorta ascendens oder bei einem Durchmesser > 5.5 cm (5.0 cm?) für die Aorta descendens

- geringere Durchmesser mit OP-Indikation bei:
  - zusätzliche kardiale Erkrankung
  - schneller Durchmesseranstieg
  - familiäres Risiko für Ruptur / Dissektion
  - bikuspeide Aortenklappe
Zusammenfassung I

- Aortendissektion >>> “daran denken”
- RR-Kontrolle ist essentiell
- Die Behandlung sollte in speziellen Zentren erfolgen
  - Typ A > Notfall-OP
  - Typ B > konservativ / Stent
- Bei Aneurysmen sollte die Operation elektiv durchgeführt werden, um das Risiko einer Dissektion zu reduzieren
Zusammenfassung II

- Die David-Operation ist die optimale operative Therapie beim Aneurysma oder einer Dissektion der Aorta ascendens.
- Das postoperative Monitoring der Aorta ist extrem wichtig.
- Patienten mit Marfan Syndrom sollten in spezialisierten Zentren betreut werden.
Vielen Dank!