Ανεπάρκεια Αορτικής Βαλβίδος
Νεότερες Χειρουργικές Τεχνικές
Aortic regurgitation. New surgical techniques

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The dissemination of AV repair has been slower than that of Mitral valve repair.

**REASONS:**

- The alternative option, Aortic Valve Replacement is effective in relieving symptoms, improving quality of life, increasing long-term survival and has low perioperative mortality. 
  
  STS Database: average perioperative mortality 3-4%

- The surgeon’s view is from the outflow side making impossible to assess and test the valve in its pressurized state.
The dissemination of AV repair has been slower than that of Mitral valve repair.

**REASONS:**

- The gradual recognition of the importance of two other distinct structures in the aortic root, the ventriculo-aortic junction (VAJ) and the sino-tubular junction (STJ)

- The luck of universal communication until recently
Reason 2: The gradual recognition of the importance of two other distinct structures in the aortic root, the ventriculo-aortic junction (VAJ) and the sino-tubular junction (STJ)
The aortic root has been opened from behind and spread apart, so that the full width of the cylinder can be seen.

Fibrous triangle in ventricle

Muscular crescent in sinus

Membranous septum

Superior
Left Right
Inferior

Reason 3: The luck of universal communication until recently
New knowledge in surgery of AR

**Isolated AR**
- New cusp procedures
- New tools for assessment of cusp geometry (EH, GH)
- Aortic Annuloplasty
- Ozaki technique
- TAVI, Sutureless Valves

**AR / Root pathology**
- Addition of aortic annuloplasty in the Remodeling /Yacoub procedure
- Patient-tailored sinus replacement/ Urbanski
- Endo-Bentall
Cusp Prolapse

Triangular Resection

Leaflet free edge Plication

Leaflet free Edge resuspension
**Geometric Height**: the maximum tissue height between insertion and free margin in the center of the cusp. 90% of the individuals studied had 18mm or more. We proceed with the repair when GH ≥ 18mm.

**Effective Height**: an EH of less than 8 to 9 mm indicates prolapse.
WHY DO REPAIRED VALVES FAIL?

Most surgeons rely on visual inspection and not on objective measurements of cusp configuration
Valve Repair = Ring Annuloplasty + Leaflet Reconstruction
Aortic Annuloplasty

• As for mitral valve repair, aortic annuloplasty is gaining wider acceptance

• Ideal aortic annuloplasty should ensure:
  • Good hemodynamics
  • Biocompatibility
  • Stability of annular base diameter reduction
  • Should be fast and easy to perform
Aortic Annuloplasty.

*Internal or external annuloplasty ring?*

Subvalvular plane is easier to be reached with internal rings

**BUT**

Endovascular placement may interfere with cusp mobility

**AND**

may increase the risk for hemolytic or thromboembolic events
Repair for isolated aortic insufficiency

6 subvalvular « U » stitches

Alignment of cusp free edges

Cusp resuspension (effective height ≥ 9 mm)

Placement of the open subvalvular ring below the coronaries

Final aspect
HAART 300
Aortic Annuloplasty Device

Ring Implantation Technique

Is used to reshape and stabilize the aortic annulus so that the aortic cusps close properly.

9 stitches for the positioning of the device under the annulus and away from the leaflets.

Once implanted, serves as a framework to guide leaflet repair.
New Model Of Aortic Valve & Root Anatomy


Clarifies relationship between leaflet and annular anatomy required for coaptation
Standardized Annuloplasty Technique

**Sizing**
Measure all 3 leaflet free-edge lengths
Choose smaller size in case of asymmetry

**3 Post Sutures**
Prolene horizontal mattress sutures with pledgets above the annulus

**6 Looping Sutures**
Two looping sutures around each ring segment
HAART 200
Bicuspid Device (Coming soon)

- Sievers Type 0 and Type 1 valves
  - Converts valve to 50% / 50% circular configuration
  - 10 degree outward flaring post
- Sized to free-edge length of non-fused leaflet
  - Confirmed with measurement of inter-commissure distance
- 9 sutures
  - 2 post sutures
  - 7 looping sutures (4 under the fused cusp)
- Approval expected in 2017
AV repair

Annuloplasty repair strategy

AV repair for AR

Normal Root (<45 mm)

Normal VAJ (<26 mm)
- Subcom. Anpl.

Large VAJ (>26 mm)
- Ring Annuloplasty

Dilated Root (≥45 mm)

Large VAJ (>26 mm)
- Modify valve geometry

VS Reimplantation
Total Root Replacement with the Bentall–Button operation

- 30-day mortality
- Thromboembolic events
- Endocarditis
- Re-intervention
- Composite valve–related events
  For a 20–year-old patient this translates into a 65% probability of a valve related event
- Still the ‘gold standard operation’ for aortic root pathology for patients over the age of 50 years.
- but also attractive to the young patients with contemporary anticoagulation protocols, self-monitoring
Valve Sparing Root Replacement (VSRR)

- Thromboembolic rate 0.3% per year
- Endocarditis rete 0.2% per year
- Re-intervention rate 1.3% /year
- Composite valve –related event rate 1.9% per year
- For a 20–year-old patient this translates into a 95% probability of a valve related event

Freedom from significant (>2+) AR at 8 years was for the David procedure 90 ±3% and for the Yacoub procedure 55 ± 6%
6 subvalvular « U » stitches

Alignment of cusp free edges prior Remodeling

Suture of the Remodeling

Cusp resuspension after the Remodeling (effective height ≥ 9 mm)

Subvalvular ring implantation
Subvalvular ring implantation
Phenotypes of the ascending aorta

- Aortic root aneurysm: Valsalva $\geq$45 mm
- Supra-coronary aneurysm: Valsalva <40 mm, Supracoronal Aorta $>45$
- Isolated AI: Valsalva <40 mm, Supracoronal Aorta <40

Standardized and physiological approach to aortic valve repair

Root reconstruction

- Remodeling + sub-valvular annuloplasty
- Supra-coronary graft + sub-valvular annuloplasty (annulus $\geq$25 mm)
- Sub-valvular annuloplasty (annulus $\geq$25 mm)

Cusp repair

- Alignment of cusp free edges
- Resuspension of cusp effective height
- Subvalvular external aortic annuloplasty

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Paul Urbanski, Anno Diegeler
Modification of the remodeling procedure with isolated sinus (1, 2 or 3) replacement - the patch technique
Reasonable modification in cases with root asymmetry
Enables precise sewing, passing the stitches exactly through the annulus rather than the aortic remnants decisive for hemostasis and durability
TAVI in pure AR
Unique challenges

• Absence of valvular calcification (suboptimal anchoring and visualization)
• Hypercontractility of the ventricle, dynamic jets (limits device control during positioning and release)
• Dilatation of the annulus (exceeds the range of commercially available prosthesis)
• Frequently dilated ascending aorta
TAVI IN PURE AORTIC REGURGITATION

Except the Jena-Valve several self-expandable TAVI devices are currently used as ‘off-label’ procedures for treatment of pure aortic valve regurgitation.

J- valve
Lotus
Symmetis ACCURATE TA

Papers show feasibility
Mid-term results debatable and currently available for small series
Transcatheter Aortic Valve Replacement for the Treatment of Pure Native Aortic Valve Regurgitation
A Systematic Review

Anna Franzone, MD,1,2 Raffaele Piccolo, MD,1 George C.M. Siontis, MD,1 Jonas Lanz, MD,1 Stefan Stortecky, MD,1 Fabien Praz, MD,1 Eva Roost, MD,1 René Vollenbroich, MD,1,2 Stephan Windecker, MD,1 Thomas Pilgrim, MD1

WHAT IS KNOWN? SAVR is the treatment of choice for native pure aortic regurgitation. However, transcatheter aortic valve replacement is emerging as a novel treatment option for high-risk patients.

WHAT IS NEW? We performed a systematic review including 237 high-risk patients with pure native aortic regurgitation undergoing transcatheter aortic valve replacement across 13 studies. The 30-day rate of mortality amounted to 7%, post-procedural AR was moderate or severe in 9% of patients.

WHAT IS NEXT? Despite encouraging initial data, expanding the indication of transcatheter aortic valve replacement to high-risk patients with pure severe aortic regurgitation requires further studies with longer-term follow-up data.
Sutureless Aortic Valve Replacement for Aortic Incompetence

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Abstract: Objective: Sutureless prostheses for surgical aortic valve replacement (AVR) are usually used in degenerative calcified aortic stenosis. Less is known on the application of sutureless prostheses for pure aortic incompetence. Methods: Between 2011 and 2014, 442 patients were operated on with the Perceval aortic sutureless valve implant. We identified 11 patients (10 female, mean age 70.5) who underwent sutureless AVR for pure aortic incompetence (off-label use). Three patients had a left ventricle ejection fraction of 30% or less. Mean logistic EuroSCORE was 15.2 (range 2.2–45.2). In five patients, associated mitral procedures (three [60%] repair and two [40%] replacement) were performed. Four procedures were performed through a minimally invasive approach (three right minithoracotomies and one partial sternotomy). Results: Mean cardiopulmonary bypass time was 130.2 min and aortic cross clamp time was 82.2 min. Mean implanted prosthesis size was 24.5 ± 1.3 (median 25) mm (insignificant correlation with preoperative aortic valve annulus measurement by transthoracic echocardiography: 21.6 ± 1.5 [median 21] mm, Pearsons r = 0.373, p = 0.259). One patient died on 24th day after AVR associated with aortic arch replacement and hypothermic circulatory arrest (10 years after correction for type A aortic dissection). No residual para- or intravalvular leakage was present on discharge and 12-month follow-up. No migration of the prosthesis occurred. Conclusion: Sutureless AVR is an option in selected patients with aortic incompetence. Preoperative aortic annulus measurement by echocardiography has poor predictive value for estimation of prosthetic valve size. doi: 10.1111/jocs.12531 (J Card Surg 2015;30:391–395)
Aortic valve pathology may play a role in this discrepancy; a regurgitant aortic valve without severe root/annulus calcification retains elastic properties of the annulus (capacity to receive a greater prosthesis), while degenerative aortic stenosis renders the aortic root complex stiff and rigid.
Aortic Valve Reconstruction with Autologous pericardium

The OZAKI procedure
The OZAKI AVNeo™ Sizer System[1]) for aortic valve reconstruction
The PEARLS Procedure
Personalized External Aortic Root Support.

- 3D-printed replica of the aorta made in thermoplastic, exo-stent made by Macroporous polymer mesh on the outside of the aortic root.
- An external stent that is placed around the aortic root as a means of preventing continued aortic root expansion.
- Can be performed (in general) without putting the patient on the heart bypass machine - also called “beating heart surgery”.
- It is unknown how long the PEARLS procedure will last, but early indications is that it is a durable procedure based on a limited number of subjects.
- The aortic valve, the root architecture and the blood endothelial interface are conserved.
**CENTRAL ILLUSTRATION:** The Pears (Personalized External Aortic Root Support) Flowchart

- **Aorta Image Series**
- **3D Modeling**
- **Plastic Model**

CMR Images After Implantation of Personalized External Aortic Root Support (PEARS)

PEARS on Aorta

PEARS on Plastic Model

Endo- bentall

Developing a single-unit endovascular device for simultaneous ascending and aortic valve is a question of time. A novel composite endovascular valved graft will extend the application of transcatheter techniques to patients denied TAVI due to a concomitant ascending aneurysm and those with acute type A dissection with high risk of mortality.

Ryalski J Cardiac Surg 2014
CONCLUSIONS

- Aortic valve repair is on its way to a rational and reproducible procedure as for mitral repair
- Aortic Annuloplasty is gaining wider acceptance for aortic repair both in isolated AR patients and in AR from root pathology
- Resuspension of cusp effective height is key step for a reproducible aortic valve repair
- Further clinical evaluation of current devices will help to define the most standardized and safe way to perform aortic valve repair
Aortic Valve Repair

ΕΥΧΑΡΙΣΤΩ ΓΙΑ ΤΗΝ ΠΡΟΣΟΧΗ ΣΑΣ
HAART 300
Aortic Annuloplasty Device

- Replicates complex 3-D annulus
  - 2:3 elliptical base geometry
  - 3 equally space subcommissural posts
  - 10 degree outward post flare
- 4 proportional sizes
  - Size designation is set to the diameter of a circle with equivalent circumference

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Personalised External Aortic Root Support Project (PEARS)

**ExoVasc: Applications**

- Aortic dilation associated with:
  - Marfan Syndrome / Loeys-Dietz Syndrome
  - Bicuspid aortic valve Disease
  - Transposition of the great arteries / ASO
  - Turner’s Syndrome
  - Tetralogy of Fallot
- Recovery of dilation-induced aortic regurgitation
- Pulmonary Autograft support in the Ross procedure

**Patient demographic: Mar 2017**

- 95 patients implanted (63 M + 32 F)
- A cumulative total of 348 post–operative patient years
- P1 @ 12.75 years, 10 patients > 10 years post op, 29 patients @ >5 years post-op
  - 18 x patients treated in their teens
  - 22 x patients treated in their 20s
  - 24 x patients treated in their 30s
  - 21 x patients treated in their 40s
  - 7 x patients treated in their 50s
  - 3 x patient treated in their 60s
Aortic valve pathology may play a role in this discrepancy; a regurgitant aortic valve without severe root/annulus calcification retains elastic properties of the annulus (capacity to receive a greater prosthesis), while degenerative aortic stenosis renders the aortic root complex stiff and rigid.