In The Name Of God

Small Aortic Root

ALIREZA A. GHAVIDEL

ASSISTANT PROFESSOR OF CARDIOVASCULAR SURGERY

WINTER 1384

What is the overall Goal of AVR ?!

What is the Small Aortic Root?

- Small Aortic root??
- Patient prosthetic mismatch??

Small valve size <21 !

Excessive T.V Gradient !

Increased TVG with exercise !

Prosthetic valve area < Native valve area !

ID / BSA ratio < 10 mm/m2 !

Indexed EOA < 90th percentile !

Indexed EOA < 0.85 ? <0.6 ? !

What is the EOA ?

$$EOA = (CSA_{LVOT} \cdot TVI_{LVOT}) / TVI_{AO}$$

Undesirable effects of P-P Mismatch!

- P-P mismatch
  - High TVG
  - Poor LV Remodeling
  - Heart failure
  - Need for Re-op

- **Peak & Mean TV gradients have a significant negative effect on freedom from heart failure after AVR. (P<0.001)**

(Hazard ratio 1.03 per mm increse in gradients)

There is significant differences in PG & MG between patients with IEOA<0.80 & IEOA>0.85. (P<0.001)

"Ruel et al. J Thorac & Cardiovasc surg 2004 "

Mismatch defined as IEOA<0.80 is independent predictors of post AVR heart failure but defined as IEOA <0.85 is not.

RUEL ET AL. J THORAC & CARDIOVASC SURG 2004 "

- ***P-P mismatch defined as IEOA<0.75 has negative impact on survival in young patient but this impact is minimal in >60 yr patients (P<0.005).***

Moon et al Ann Thorac Surg 2006

Moon et al Ann Thorac Surg 2006

- P-P mismatch (IEOA<0.75) is not important in small patients but negatively impacted on survival for average & large patients with mechanical valves.

	BSA<1.7	BSA 1.7 -2.1	BSA>2.1
Negative effect on survival	P=0.32 P=0.37	P<0.05 P<0.005	P<0.04 P=0.4

Controversies;

- The clinical relevance of a small difference in gradient in otherwise asymptomatic patients is unclear.
- Lower IEOA is predictor of poorer NYHA early after AVR , but not important during 7-year follow up.

Controversies;

- ***In a meta-analysis of 13258 patients underwent AVR with small valve size showed that operative mortality increase by less than 1% in the 10% of cases with small prosthesis*** **BUT**

- ***Did not reduced midterm or long term survival.***

Blackstone et al J Thorac & Cardiovasc surg 2003

Controversies;

- Overall survival is same between patients with & without P-P mismatch BUT

- Valve related mortality & morbidity are higher in P-P mismatch group.

What do we can manage?

2 OPTIONS!!

THERE IS NO IDEAL PROSTHETIC VALVE !

ALL MECHANICAL & STENTED BIOPROSTHESIS ARE INHERENTLY STENOTIC!

Best device ??

- Aortic allografts (homograft) is the best devices in small aortic root because of excellent hemodynamic performance & large EOA and very low gradient.

AND

Is choice for treatment of PVE or NVE in small aortic roots

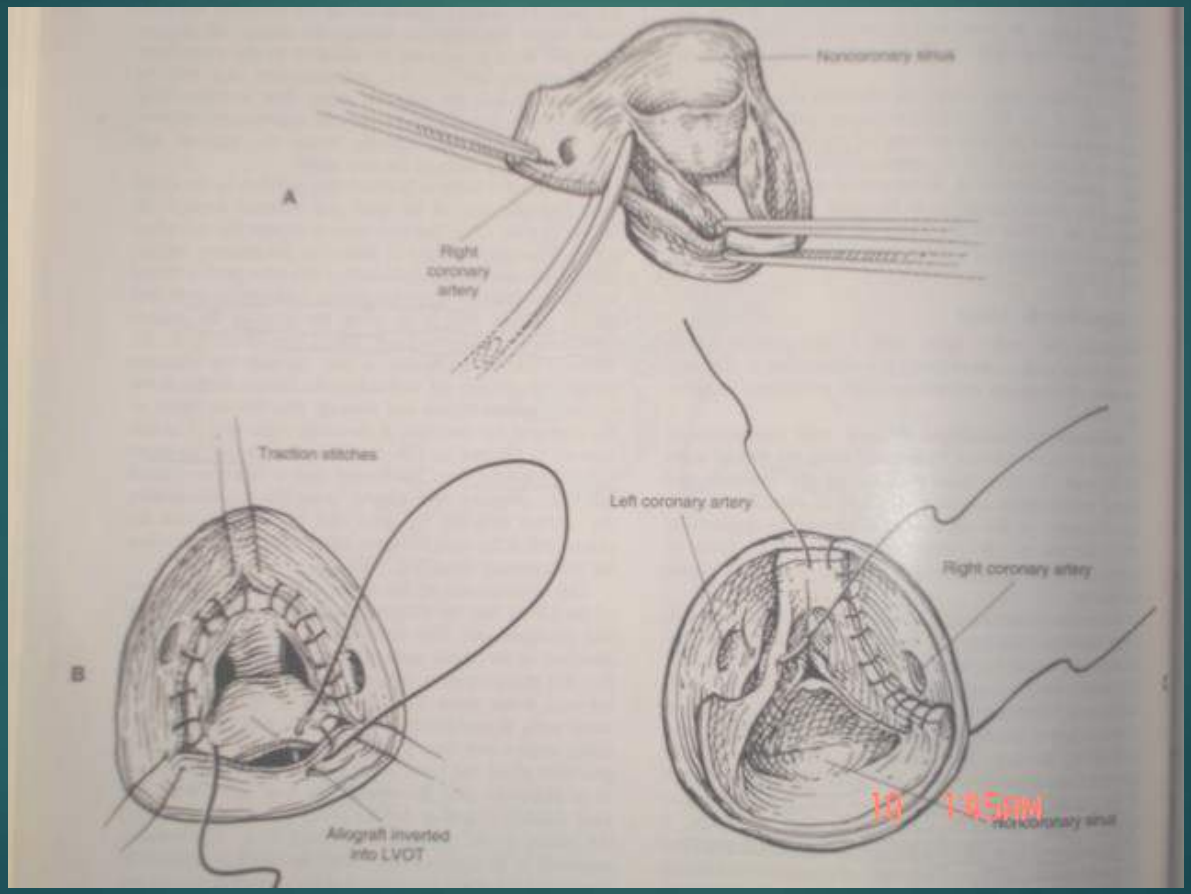
BUT !!

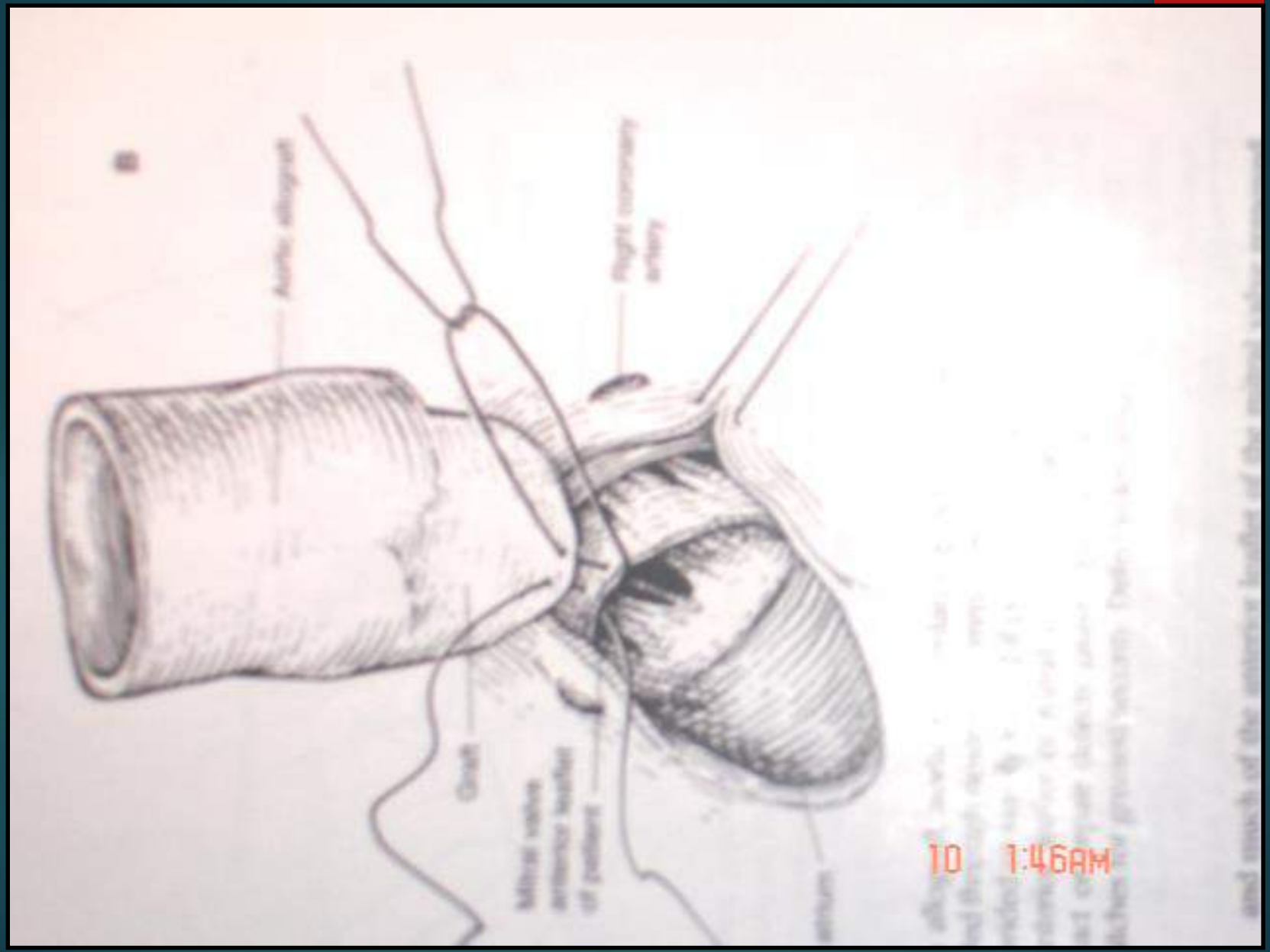
Contraindicated in:

- I) Heavily calcified & noncompliant small aortic roots.
- II) Patients <20 yr. Because of valve degeneration .

may be in sever poorly controlled HTN & aortic annulus greater than 30mm

Operative techniques: Subcoronary method

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Clinical results:

- Hospital mortality: 4 -7%
- 5 year survival: 84-91%
- Freedom from SD. : 80-94% at 5 yr.
  19-32% at 20 yr.
- Freedom from Re-op: 38-50% at 20 yr.

Pulmonary autografts:

- Best option for young otherwise healthy active patients because of growth ability.

  (8.4% at first month , 11.3% at first year)

- Has excellent homodynamic profile , comparable with allografts .(mean G. =3 mmhg)

- Has excellent mid-term results

but

More complex procedure &need for re-operation

- Contraindicated in

- Significant PV disease
- Marfan syndrome & connective tissue disease.
- Anomalies of coronary artery disease.
- Sever underlying disease.

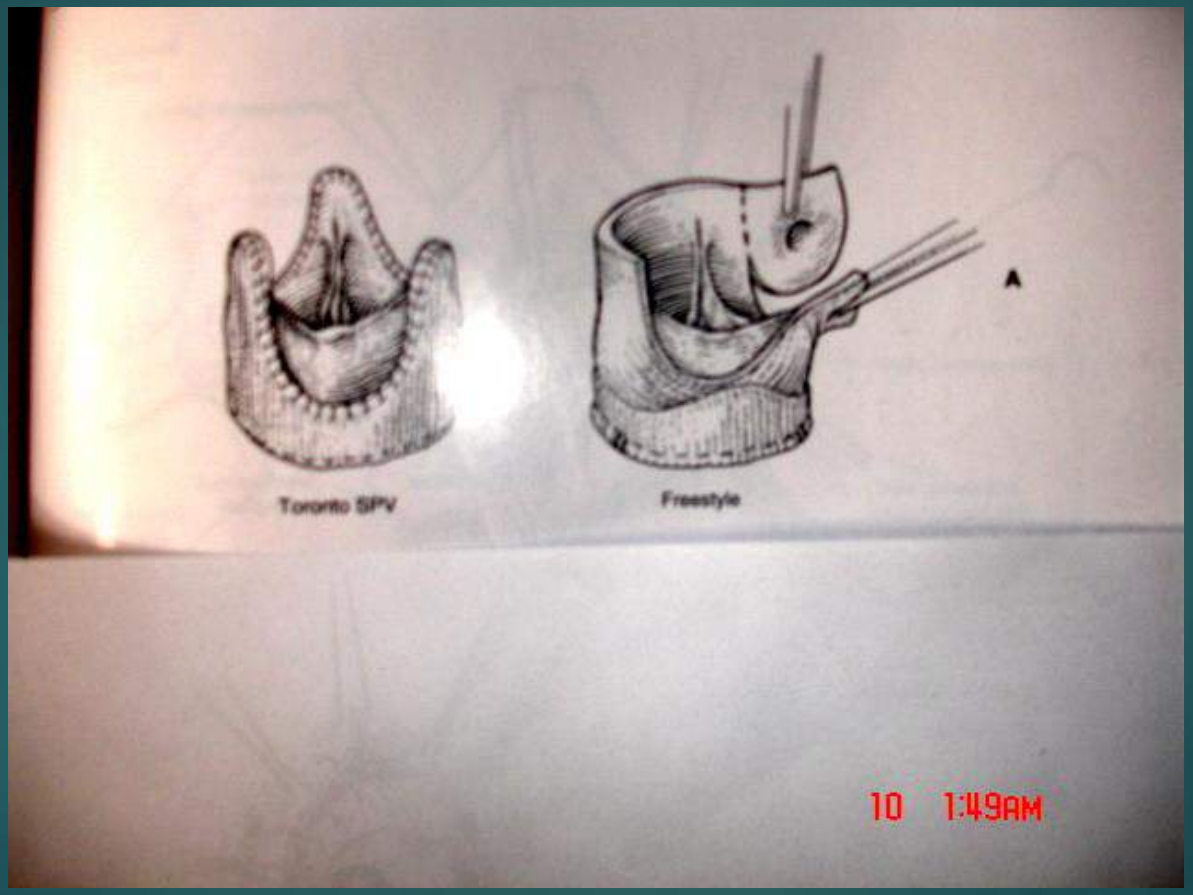
Clinical results:

- Hospital mortality: 0 – 1.7%
- Valve related late death: 1.7- 3 %
- Early autograft dysfunction: 1.5%
- Homograft insufficiency: 9.5%
- Homograft stenosis: 24-30%
- Trivial neo aortic insufficiency: 53%
- Mild to moderate insufficiency: 3%
- Re-do AVR: 1.5%

Stentless Bioprosthesis:

- Medtronic freestyle
- Edward lifescience prima plus
- CryoLife –O'Brien
- Aortech freesewn
- St. Jude toronto SPV
- Biocor PSB/SJM
- Sorin pericarbon

Stentless Bioprosthesis:



- Survival advantage of 5-fold than stented bioprosthesis.
- Hemodynamic profiles are good & mean TVG is about MG of homografts & generally <10 mmgh.
- After few month EOA actually increase & LV hypertrophy regress .
- EOA is consistently good even in small valve size (19 & 21mm).

Clinical results with freestyle

Bach et al J Thorac & Cardiovasc surg 2004

	Valve related death %	SD %	Mod.or more AI %
Subcoronary	3	2	5.1
Total root	7.7	0	3.9
inclusion	11.2	0	6.6

TVG were slightly lower (P<0.009) & EOA (P<0.02) and freedom from AI (P=0.02) were slightly higher with total root versus subcoronary method.

BACH ET AL J THORAC & CARDIOVASC SURG 2004

- **In small IEOA & small valve size (21mm) the recommendation is total root technique instead of subcoronary method because :**

- **PPM is rare in this method & implantation method don't increase the operative risk.**

Ennker et al J heart valve Dis. 2005

Matsue et al J heart valve Dis. 2005

Bach et al J Thorac & Cardiovasc surg 2004

Stentless aortic valve for patients with sever LV dysfunction even if technically more demanding than stented valves is a safe procedure that warrants a larger IEOA leading to enhanced LVEF recovery

BEVILACQUA ET AL ANN THORAC SURG 2002

New series of mechanical heart valves

- St. Jude HP series .
- St. Jude regent type.

- Carbomedics R series
- Carbomedics Top Hat

The SJM Regent™ mechanical heart valve represents the next dimension in the ...nology. Delivering unprecedented hemodynamics and performance, the SJM Regent™ valve ...tains the design features that have resulted in the lowest complication rates as well as ...ding exceptional structural integrity and durability.™

Geometric orifice area (GOA)

	19 mm	21mm
St. Jude	1.21 cm2	1.81
St. Jude regent	1.6	2
Carbomedics	1.12	1.66
Carbomedics Top Hat	1.59	2.07

St. Jude 19 HP & 21 standard

ninami et al Ann Thorac Surg 2002

	St. Jude 19 HP	St. Jude 21 SD
Peak gradient (P<0.06)	23.3 +/-10.5	27.9 +/-9.9
Early death	none	none
6 year survival (p=0.33)	92.3%	100%
valve related morbidity (p=0.54)	1.09 % per patient/yr	1.02 % per patient/yr

St. Jude 19 HP
IEOA: 0.93cm2 /m2

	St. Jude 19 HP	St. Jude 21 SD
MG at rest	8 mmgh	9.5
PG at rest	15.4	19.1
MG at stress	12.9	16.5
PG at stress	28	35.3

- St.Jude SD & Carbomedics 21mm have favorable performance at rest high output conditions.

- The 19 mm St.Jude 19 HP show hemodynamic performance equal to 21 St. Jude SD & 21 Carbomedics

Regent type St Jude valve

	19 mm	21mm	23 mm
Mean Gradient mmgh	13.8	7.4	5.4
EOA cm2	1.6	2	2.2

Clinical results of Regent type St. Jude valves

- **1) excellent hemodynamic performance even in large BSA**
- **2) significant LV mass regression during 6 month (from 169.1 to 137.2 $P<0.0001$)**
- **LV mass regression is higher at first 2 month & no differences has seen between different valve size.**
- **Long term clinical results is on-going.**

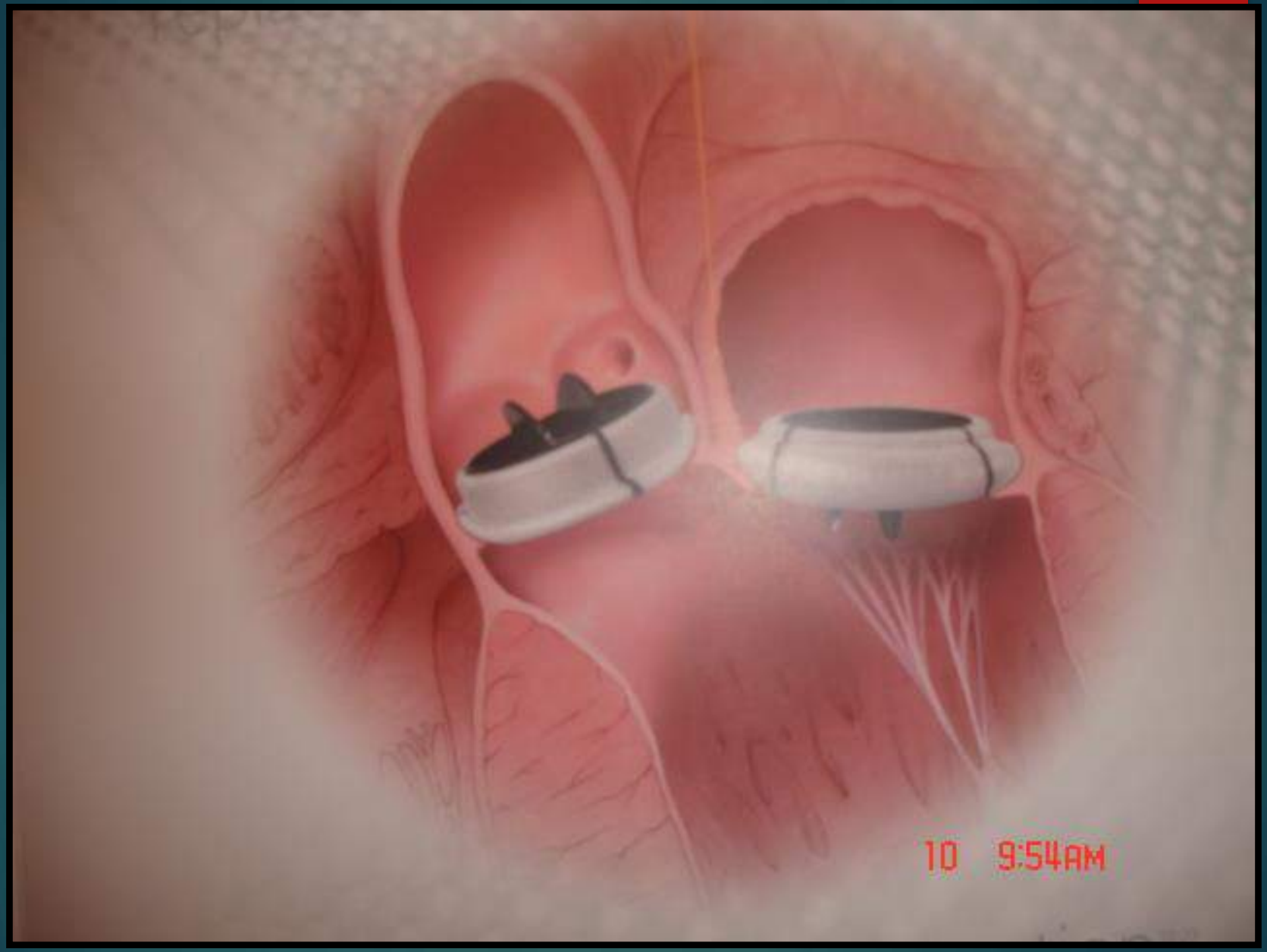
Gelsomino et al J Card Surg. 2003

In patients who require a 21 mm valve Diameter enhanced prosthesis provide lower TVG but LV remodeling occurred in all valve type

Albes et al Ann Thorac Surg 2003

	CM standard	St. Jude HP	St. Jude Regent
21 mm	15.6	11.9	9.9
23 mm	7.8	9.5	7.7

The Top Hat Carbomedics valves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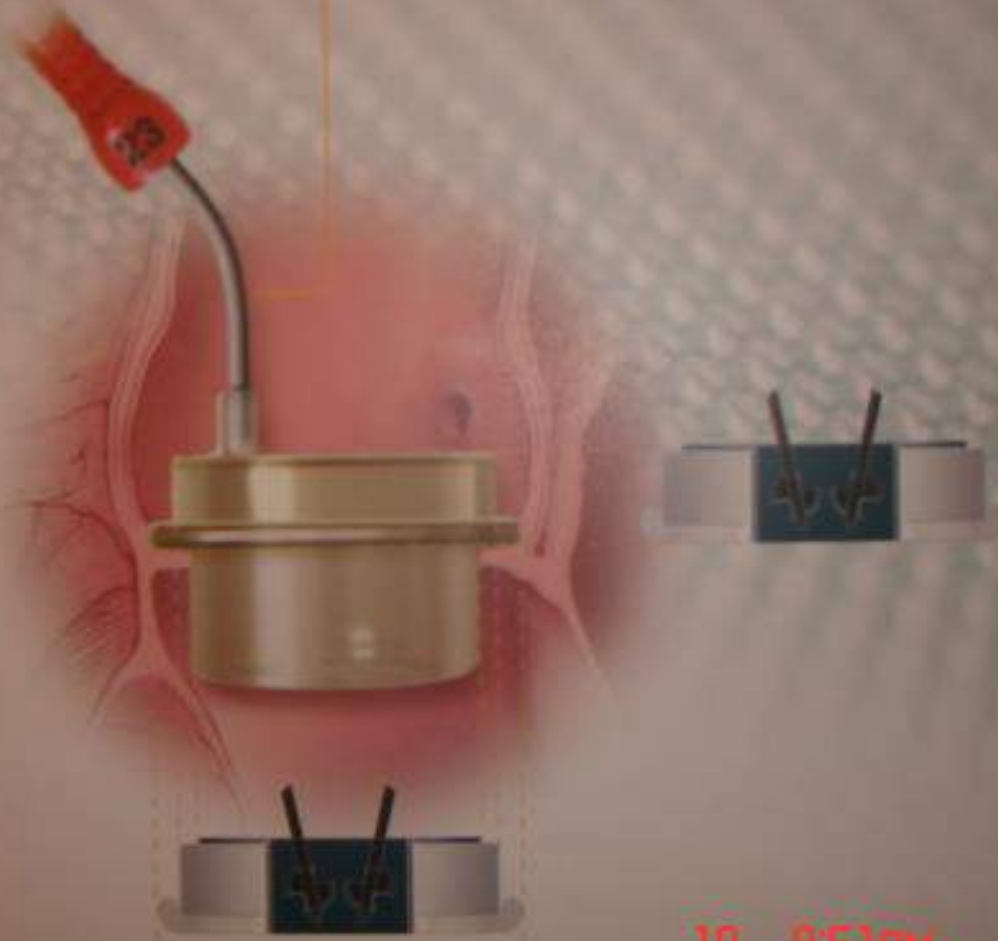
sizers

New generation sizers make sizing intuitive and simple, facilitating the whole implant procedure.



The lower barrel of the Top Hat sizer should slip into the annulus and stop at the base of the flange portion as shown in the figure. The barrel oversizes the patient's tissue annulus diameter (TAD) which

An intra-annular prosthesis constricts flow by occupying up to 40% of the available flow area and increasing gradients by as much as two times.

Top Hat provides maximum blood flow by placing the valve completely above the annulus.

TAD in an intra-annular prosthesis corresponds to the external sewing cuff diameter, which is the labeled size*.

TAD in a supra-annular prosthesis corresponds to the internal valve diameter,* which is **not the Top Hat labeled size**

Tissue Annulus Diameter: 19mm

Intra-Annular valve size:	Top Hat Supra-Annular valve size:
19 mm	**23 mm**

18 mm ATS , 19 SJM Regent ,19 Sorin Bicarbon , 19 mm On-X , 21 CM Top Hat

- **Sorin Bicarbon Slimline & SJM Regent showed the lowest Mean & Peak gradient at increasing cardiac output & had the best performance**
- **ATS & SJM Regent showed the largest regurgitant volume & the Sorin had lowest.**
- *Bottio et al J Thorac Cardiovasc Surg. 2004*

Surgical approaches for aortic root enlargement:

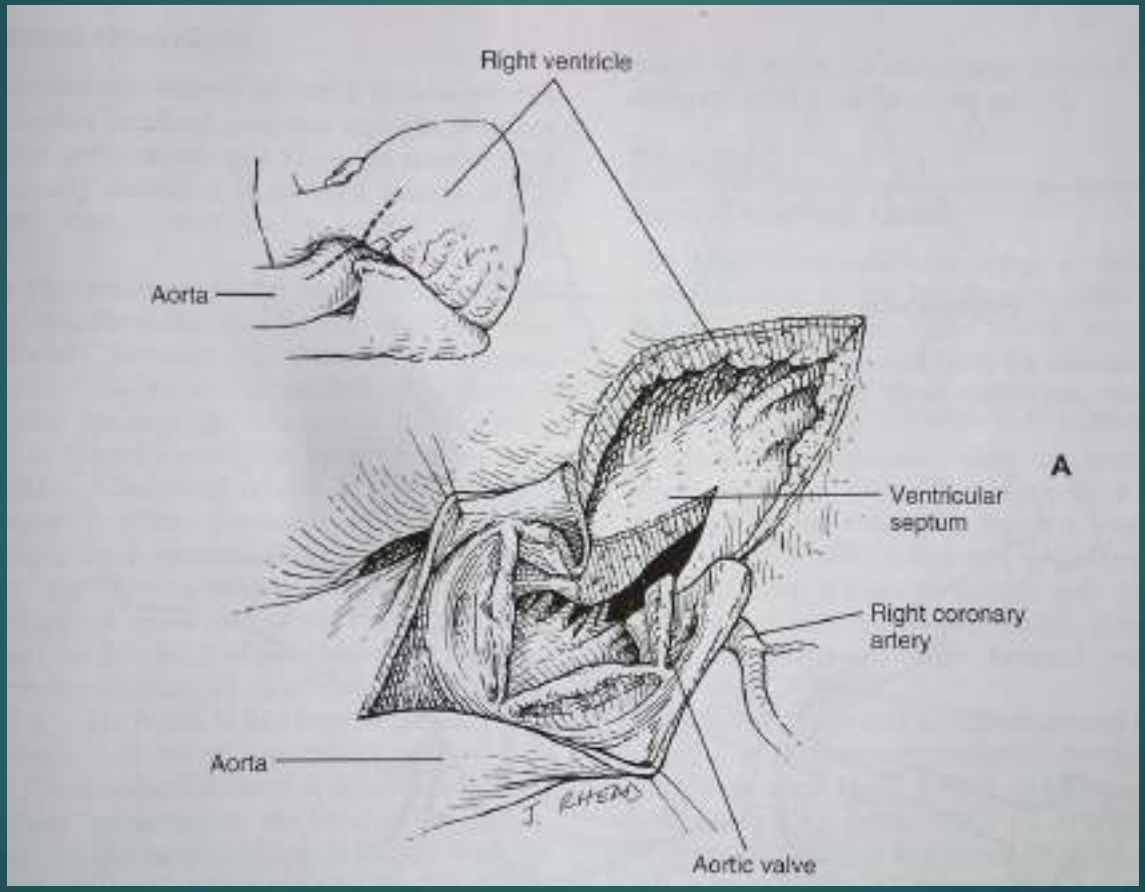
1)ANT. APPROACH AORTOVENTRICULOPLASTY;

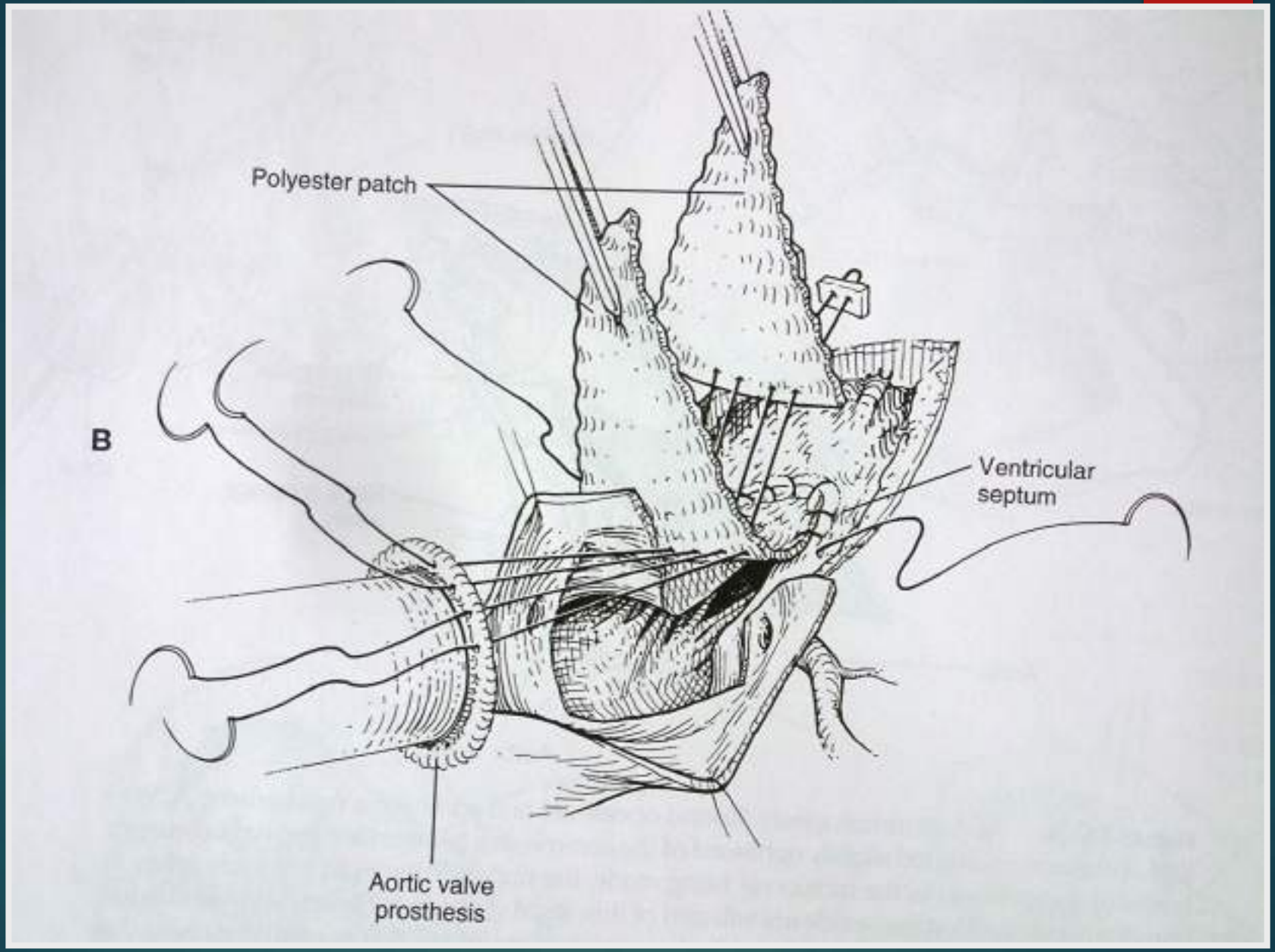
RASTAN-KONNO & ROSS- KONNO

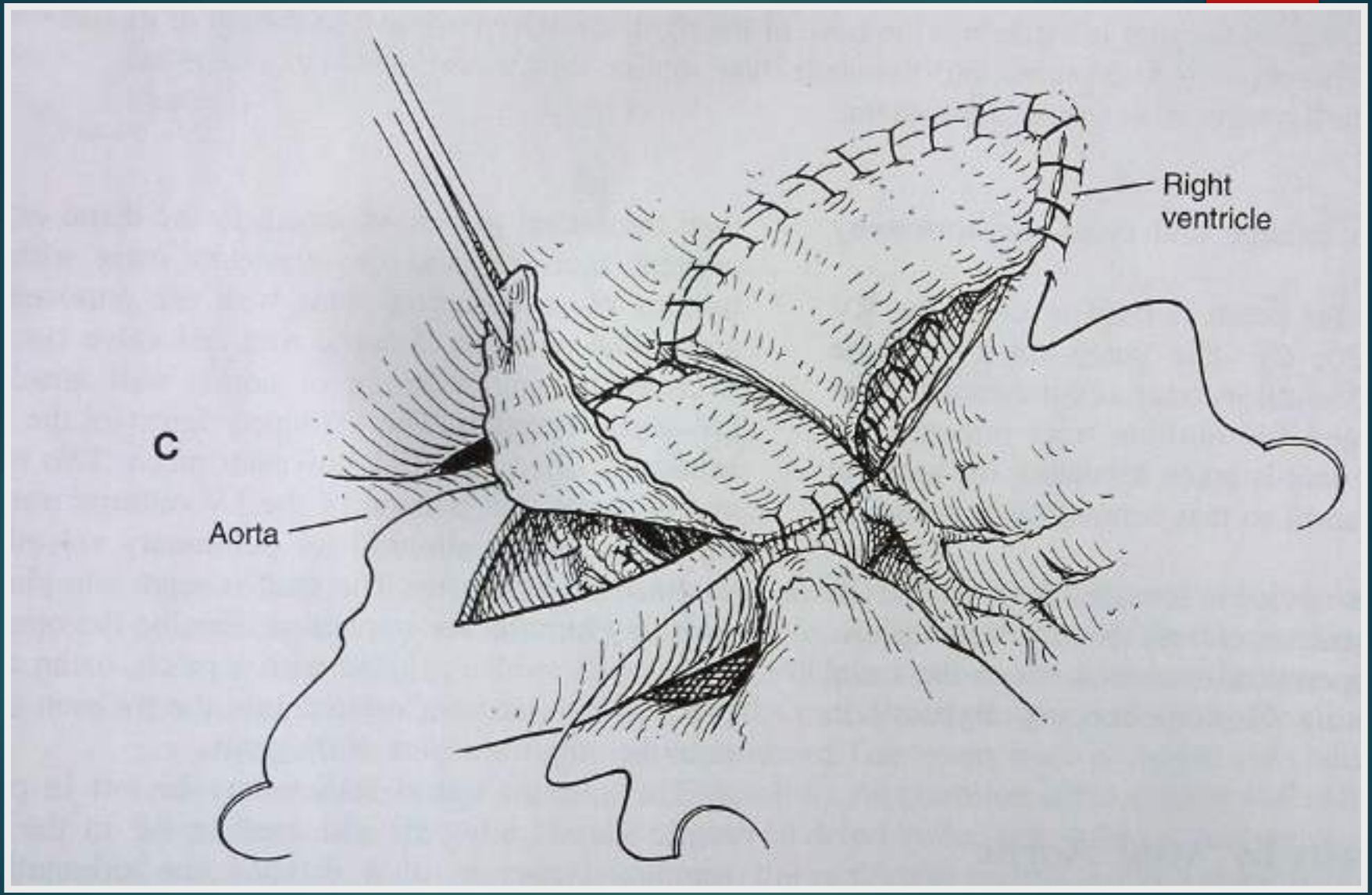
2) POST. APPROACHES AORTOPLASTIES:

NICK'S & MANAUGUIAN METHODS

Rastan konno procedure




Polyester patch
B
Ventricular septum
Aortic valve prosthesis


C
Aorta
Right
ventricle

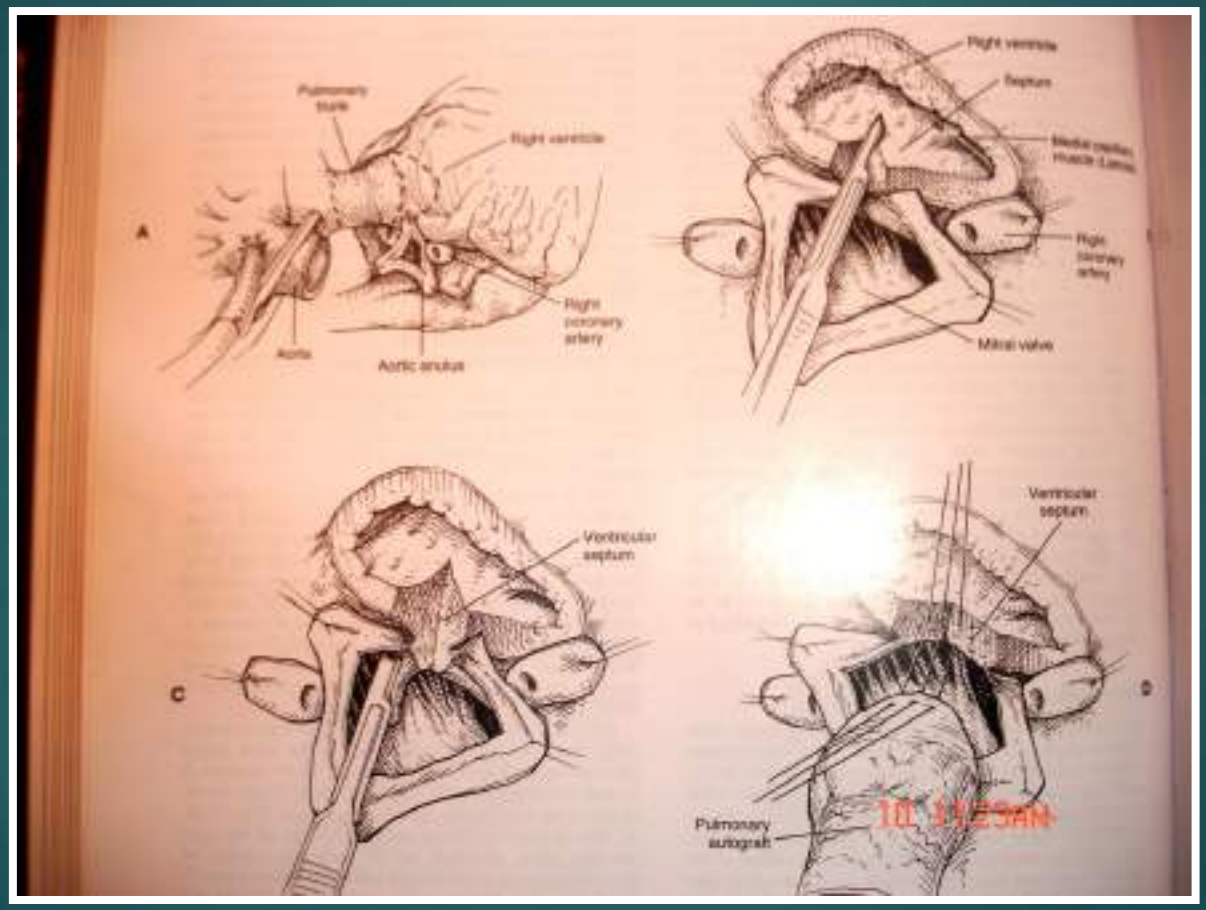
- The Rastan- Konno aortoventriculoplastyusefor diffuse tunnel shape subaortic stenosis, recurrent stenosis of LVOT as a choice procedure.

- This technique can be used as a alternative method for AVR in small aortic roots especially in Re-do operations.

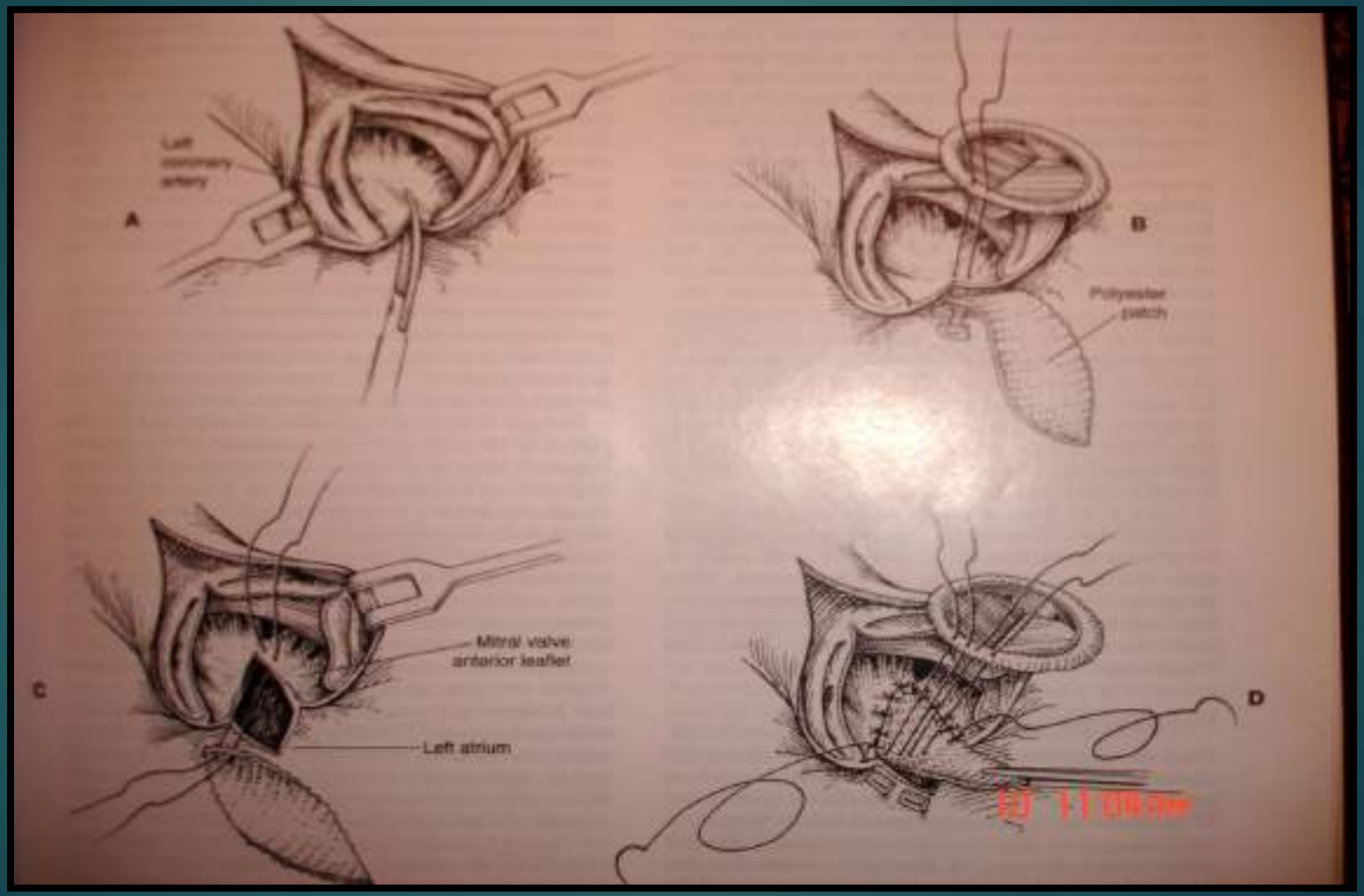
Clinical results:

- Hospital mortality : 8-34%
- Late survival : 10-15 year 85-93%
- Permanent CHB: 6-38%
- Post-op NYHA class I: 73-87%

Ross –Konno procedure indicated in complex SAS requiring AVR



Posterior approach



Aortic circumference increase 20mm
post-op PG <18 mmHg
annulus diameter increase 3-5mm

LONG TERM MORTALITY & MORBIDITY AFTER ROOT ENLARGEMENT MIGHT BE SUPERIOR TO AVR WITH STANDARD SMALL VALVE PROSTHESIS

Clinical results:

- Hospital death: 0 – 12% (mean=4.4%)
- Freedom from valve related death:97.6% in 6 yr
- Induced MR 14% but did not progress to heart failure or MVR

	SJM 19 SD	manoug uian
Hospital Death P=0.1	5.9%	3.6%
10 yr survival P<0.05	62.7%	85.7%

LV apicoabdominal aortic valve conduit use in patients with second or third replacement that have no periprosthetic lekage as alternative for root enlarging technique

conclusion

Age ,BSA, lifestyle, drug compliance underlying disease of the patients

&

experience of surgeon , availability of devices, IEOA of available device

MUST BE EVALUATE WHEN WE CHOSE A DEVICE FOR A SMALL AORTIC ROOT

The overall recommendation is use of devices that have IEOA>= 0.75 cm2/m2

&

GOLD STANDARD IS IEOA>=0.85

New mechanical devices & third generation stentless bioprosthesis are sufficient for 19 mm or more aortic annulus

&

A 19mm St. Jude HP & regent type is sufficient for patients with BSA<1.6 m^2

A 19mm Standard St Jude valves is sufficient for women with BSA<1.47 m2

&

CAN BE USED CAUTIOUSLY & INFREQUENTLY IN SOME CIRCUMSTANCES IN SMALL SEDENTARY MAN(POSSIBLE SERIOUS PROBLEM ONLY IN LONG TERM)

As the occurance of PPM is rare in total root replacement, & this method don't increase operative risk, the recommendation is made to consider this way if a small IEOA is expected

In otherwise

- Enlargement of aortic root is recommended to achievement of better hemodynamics & reducing residual LVOT stenosis , poor LV mass regression and ongoing heart failure

- Post. Approach is more simple & safer than

Ant. approach

but

IN CHILDREN & YOUNG AGE OTHERWISE HEALTHY PATIENTS WITH AORTIC SIZE <19 MM ROSS OPERATION PREFFERED TO ROOT ENLARGEMENT PROCEDURES


SHAHEED RAJAIE
HEART CENTER
Thank you