Minimally Invasive Proximal Aortic Surgery: Feasible? Reproducible?

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Minimally Invasive Aortic Surgery

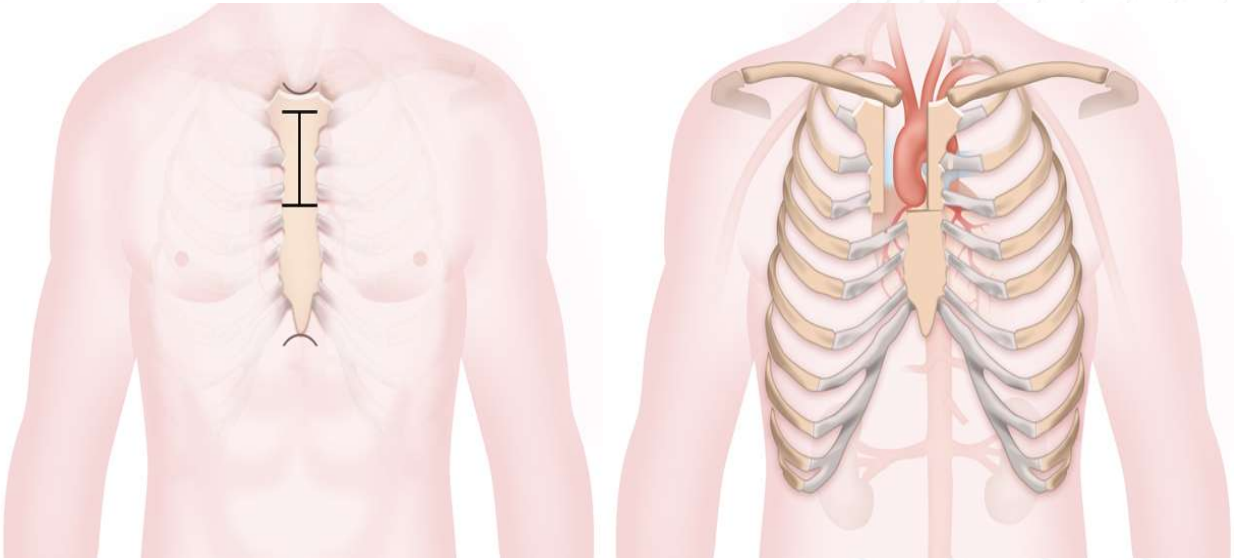
- Aortic surgery traditionally requires full sternotomy
- Recently mini sternotomy has been introduced
- Technical aspects **should not be compromised**
- Utilization of facilitating technologies is important

Principles of Minimally Invasive Root Surgery

- Interpretation of TEE images
- Strategic incision
- Safe cannulation
- Myocardial protection
- Excellent exposure
- Facilitating Technologies
- Prevention of bleeding

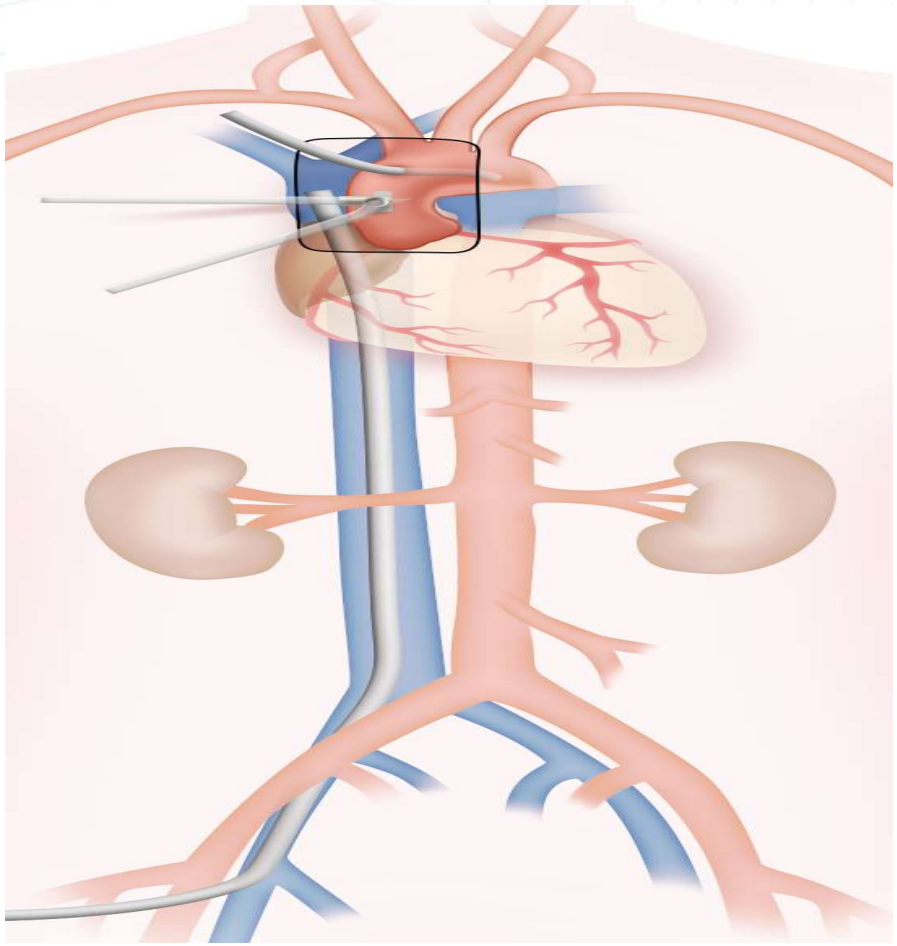
Minimally Invasive Aortic Root Surgery

- 6 cm incision
- Sternal notch to 3d or 4th intercostal space
- J-type or T-type



Cannulation Strategy

- Ascending Aorta/Arch
  (Seldinger Technique, TEE)
- Superior Vena Cava via the
  Right Common Femoral Vein
  (Seldinger Technique, TEE)



CPB Strategy

- Minimize CPB circuit
- Y the venous line
- Avoid Haemodilution
- Retrograde Autologous Priming
- Hemofiltration after Del Nido administration

Myocardial Protection
Del Nido

Avoid Multiple Cardioplegia Doses

Long Lasting Protection

Avoid Coronary Sinus Catheters

MIS Aortic Surgery:
Delivery strategy

- No Aortic valve insufficiency:
  - 1,2 liter single dose
  - Directly in the aortic root
  - Repeat dose (0,6 lt) after 90 min

MIS Aortic Surgery: Delivery Strategy

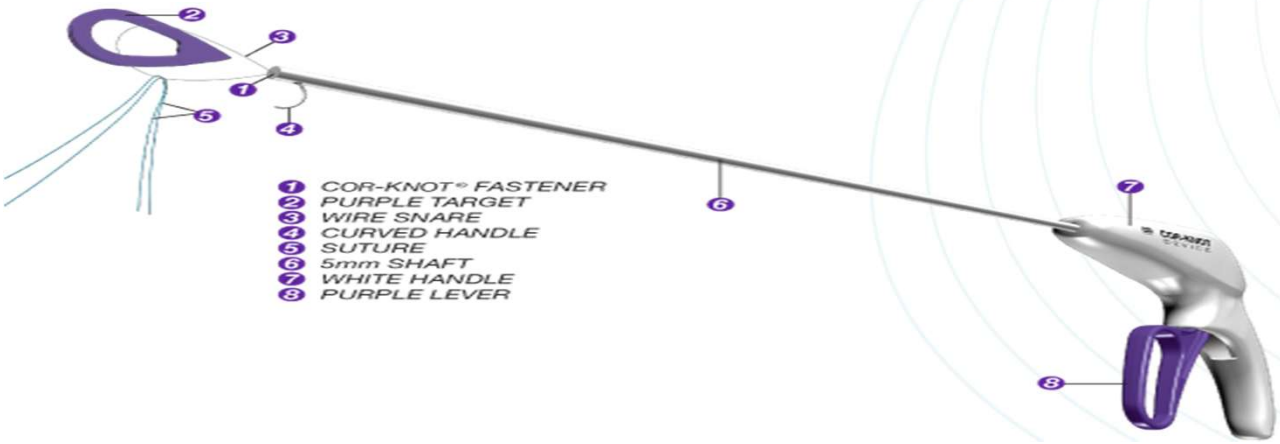
- Aortic valve insufficiency
  - Initial dose in the root until heart arrests

    TEE to assess LV dilation

    Remaining Del Nido directly in the coronary ostia
  - Retrograde administration

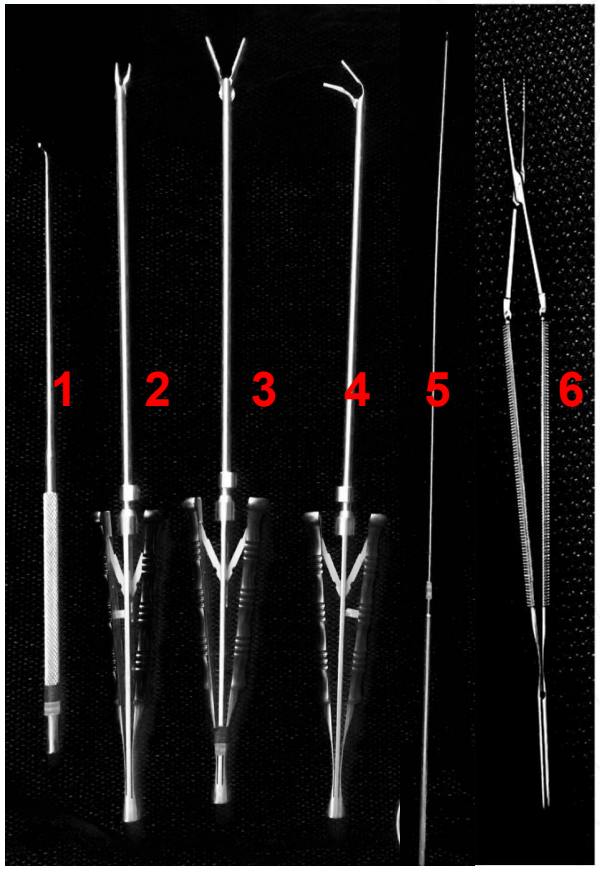
Cor-Knot

- Cor-Knot (automated suturing device)
  - Fast
  - Uniformly pressured sutures
  - Precise



Instruments

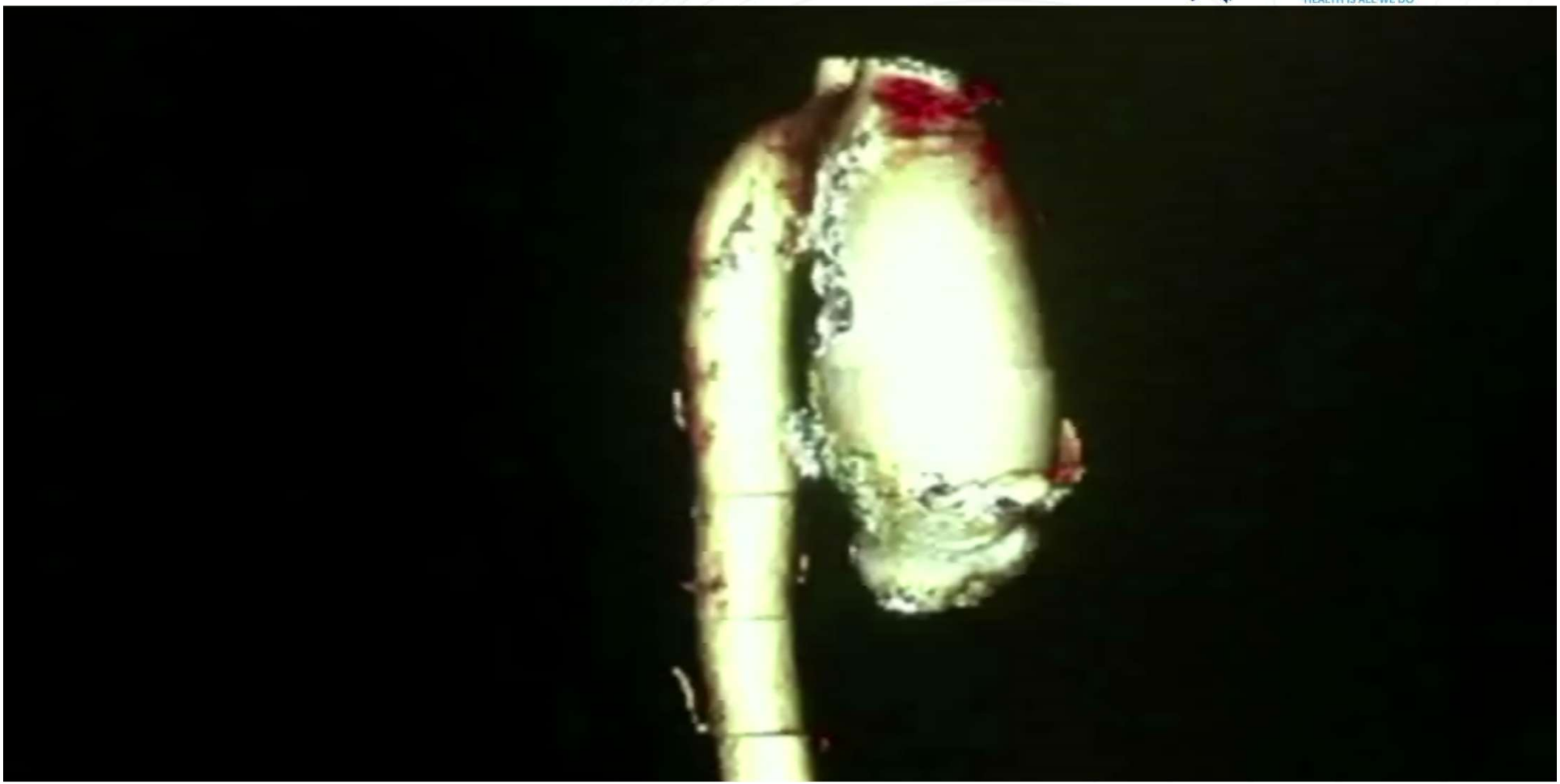
1. Vascular hook
2. MIS Needleholder
3. MIS Forceps
4. Knot Pusher
5. Crochet Hook
6. Resano Forcep



Ascending Aorta Replacement + AVR

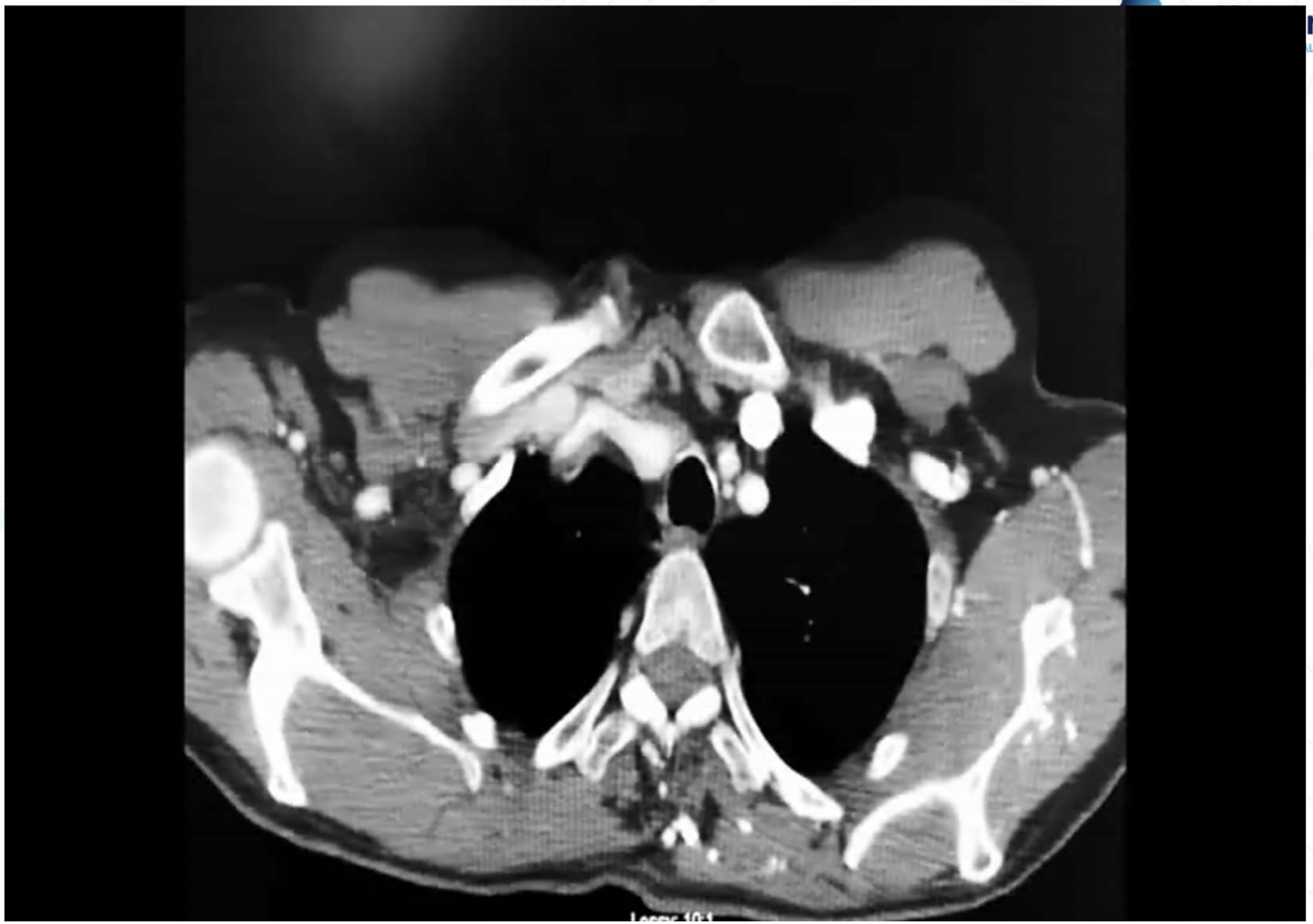
31 yo female

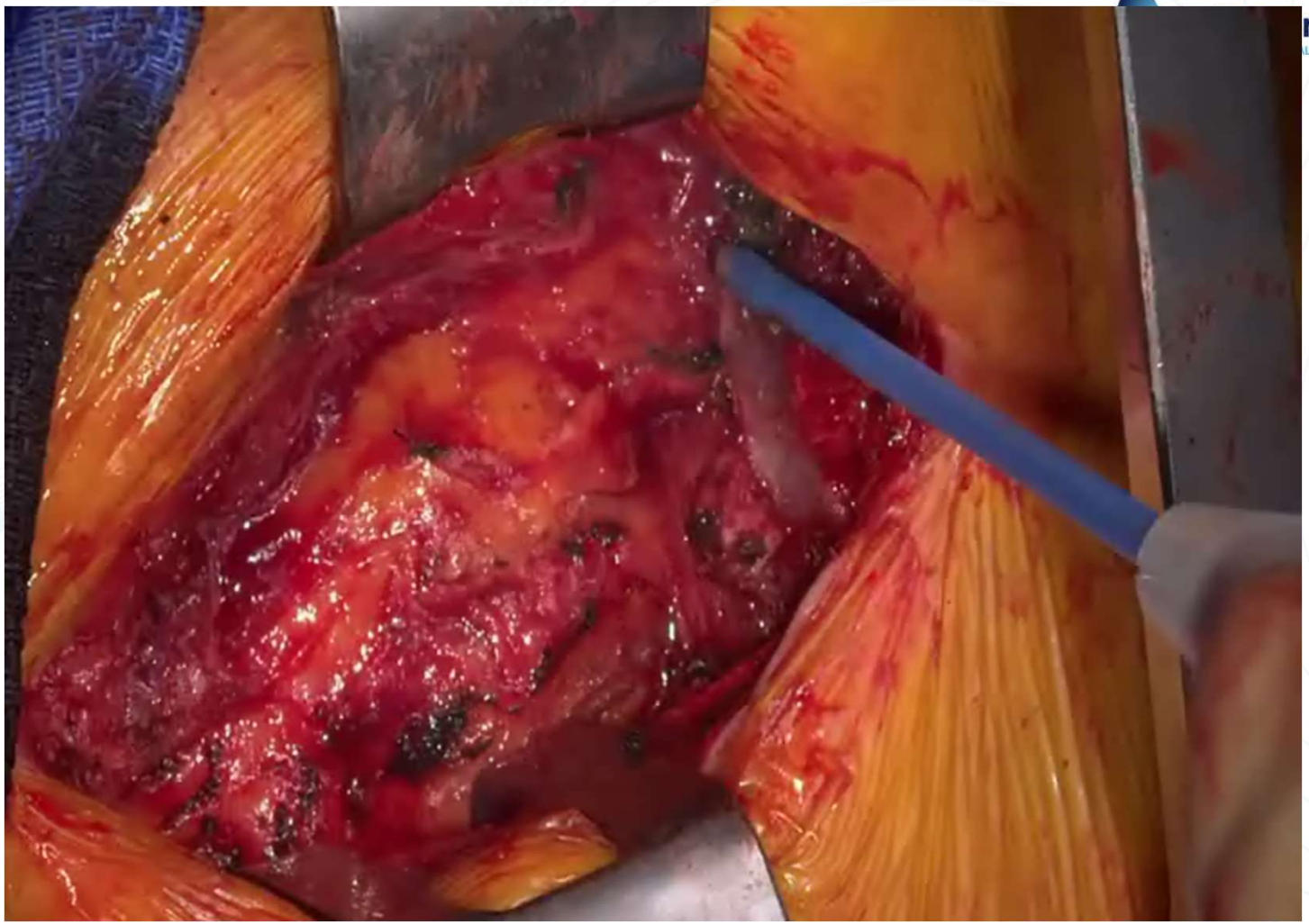
- Asymptomatic
- Severe AI
- Bicuspid AV
- Ascending Aortic Aneurysm



Reoperative surgery

55 yo male
s/p AVR
Ascending aortic aneurysm





Ascending Aorta ± AVR

Total = 301

2000-2024

	Mini (n=149)		Full (n=152)	
Age	62±13		63±13	
Males	96	64%	98	64%

Exclusion: Arch, Root, David, CABG, Dissection

Ascending Aorta ± AVR

	Mini (n=149)	Full (n=152)
Pump time	133±42	124±71
Clamp Time	102±35	95±58

Ascending Aorta ± AVR

	Mini (n=149)		Full (n=152)	
Death	1	1%	5	3%
Stroke	0	0%	3	2%
New RI	0	0%	2	1%
PVS	6	4%	13	8%

*RI – Renal Insufficiency
**PVS – Prolonged Ventilatory Support

Ascending Aorta ± AVR

	Mini (n=149)		Full (n=152)	
Bleeding	3	2%	7	5%
Afib	31	21%	33	22%
Reintubation	1	1%	5	3%

Ascending Aorta ± AVR

	Mini (n=149)	Full (n=152)
PRBC	0.8±1.4	1.5±3.0
FFP	0.7±1.3	0.7±1.5
Platelet	0.8±1.0	0.7±1.2
Cryo	0.9±1.8	1.1±1.8

Ascending Aorta ± AVR

	Mini (n=149)	Full (n=152)
ICU Days	3.7 ± 3.7	4.3 ± 4.0
Hospital Days	7.6 ± 4.5	8.3 ± 4.5

Mini Ascending and AVR

	Upper hemisternotomy (n = 50)	Full sternotomy (n = 50)	P
Age, years	62.5 ± 11.5	62.2 ± 10.7	0.88
Male	41	41	1.0
Bicuspid aortic valve	25	18	0.16
Ascending aorta size, cm	4.7 ± 0.6	4.7 ± 0.6	0.88
Ejection fraction, %	57.9 ± 12.3	54.4 ± 11.4	0.14
Aortic insufficiency, moderate or severe	26	28	0.31
Aortic stenosis, moderate or severe	22	23	0.32

Mini Ascending and AVR

	Upper Hemisternotomy N=50	Full Sternotomy N=50
CPB time	150	164
ACC time	121	131*
RBC	0	0
FFP	0	0*
Cryoprecipitate	0	0
Platelets	1	0

Mini Ascending and AVR

	Upper Hemisternotomy N=50	Full Sternotomy N=50
Mortality	1	0
Stroke	1	1
PVS (>24h)	3	3
Renal Insufficiency	0	0
Bleeding	1	2
Pacemaker	0	2
ICU LOS	3	3
Hospital LOS	7	8*

Aortic Root Repair

Root Aneurysm

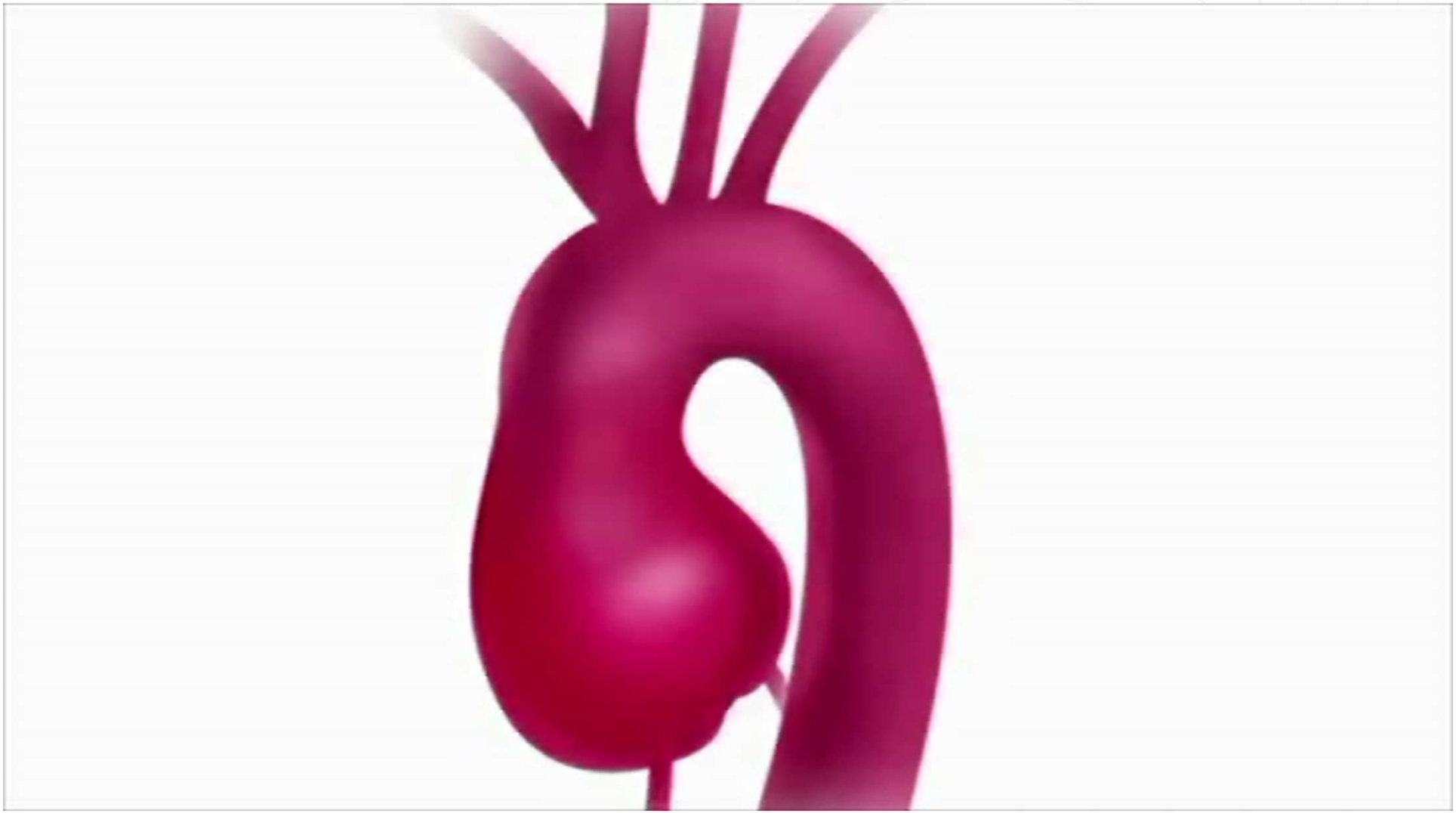
Bentall procedure

David procedure

Mini Bentall

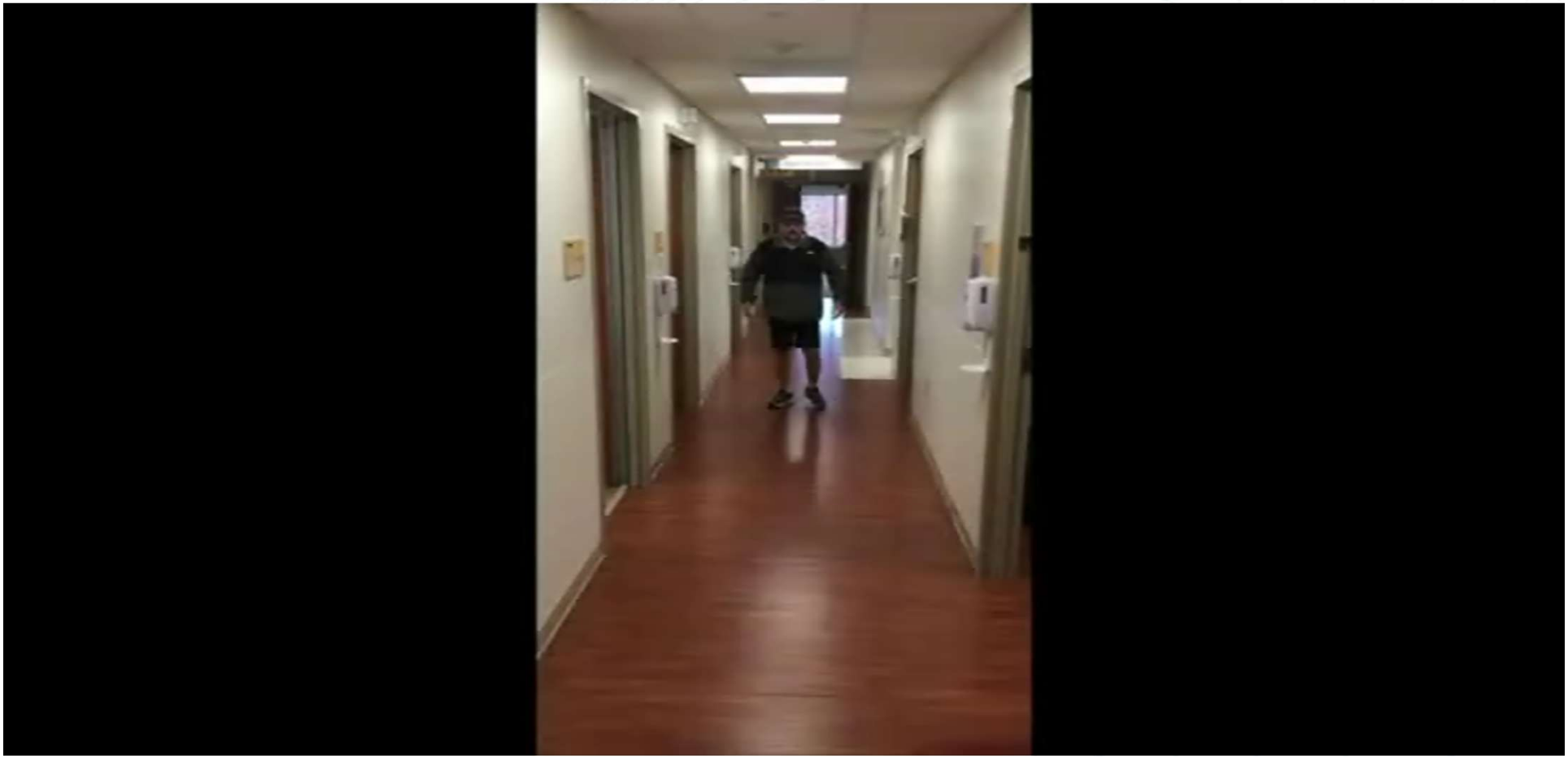
70 year old male

- Root and Ascending Aortic Aneurysm
- Moderate AR



Follow up - 2 weeks

2 weeks post operatively



Composite Valve Graft Replacement:
N=268
2000-2024

	Mini (n=67)		Full (n=201)	
Age	60±12		57±13	
Males	60	90%	163	81%

Exclusion criteria: Acute Dissections, associated Arch surgery, root Infection

Composite Valve Graft Replacement:

	Mini (n=67)	Full (n=201)
Pump time	180±31	211±53 *
Clamp Time	149±24	156±29

Composite Valve Graft Replacement:

	Mini (n=67)		Full (n=201)	
Death	0	0%	2	1%
Stroke	1	1%	1	0%
New RI	0	0%	3	1%

*RI – Renal Insufficiency

Composite Valve Graft Replacement

Complications

	Mini (n=67)		Full (n=201)	
Bleeding	1	1%	17	8%
Afib	16	24%	51	25%
Reintubation	0	0%	6	3%

Intra-Operative Blood Use

	Mini (n=67)	Full (n=201)
PRBC	0.9±1.6	2±3.9 *
FFP	1.3±1.7	1.7±2.3
Platelet	1.1±1.1	1.5±1.7
Cryo	1.3±2.0	2.5±3.3

Composite Valve Graft Replacement: Hospital stay

	Mini (n=67)	Full (n=201)
ICU Days	3.7±2.6	5.2±5.9 *
Hospital Days	8.3±4.5	12.5±8.8*

Mini Bentall

Characteristic	Mini-Bentall (N = 48)	Full-Bentall (N = 49)
Age, y, mean ± SD	60.7 ± 11.7	59.0 ± 11.7
Male sex, n (%)	42 (87.5)	39 (79.6)

Mini Bentall

Parameter	Mini-Bentall (N = 48)	Full Bentall (N = 49)	*P* value
Hospital mortality, n (%)	0 (0.0)	0 (0.0)	—
ICU LOS, d, median (IQR)	3 (2-5)	3 (2-4)	.743
Hospital LOS, d, median (IQR)	6 (5-8)	7 (6-8)	.086
Stroke, n (%)	1 (2.1)	0 (0.0)	.310
PVS (>24 h), n (%)	4 (8.3)	11 (22.5)	.055
Renal insufficiency, n (%)	0 (0.0)	0 (0.0)	—
Reoperation for bleeding, n (%)	0 (0.0)	4 (8.2)	**.043**

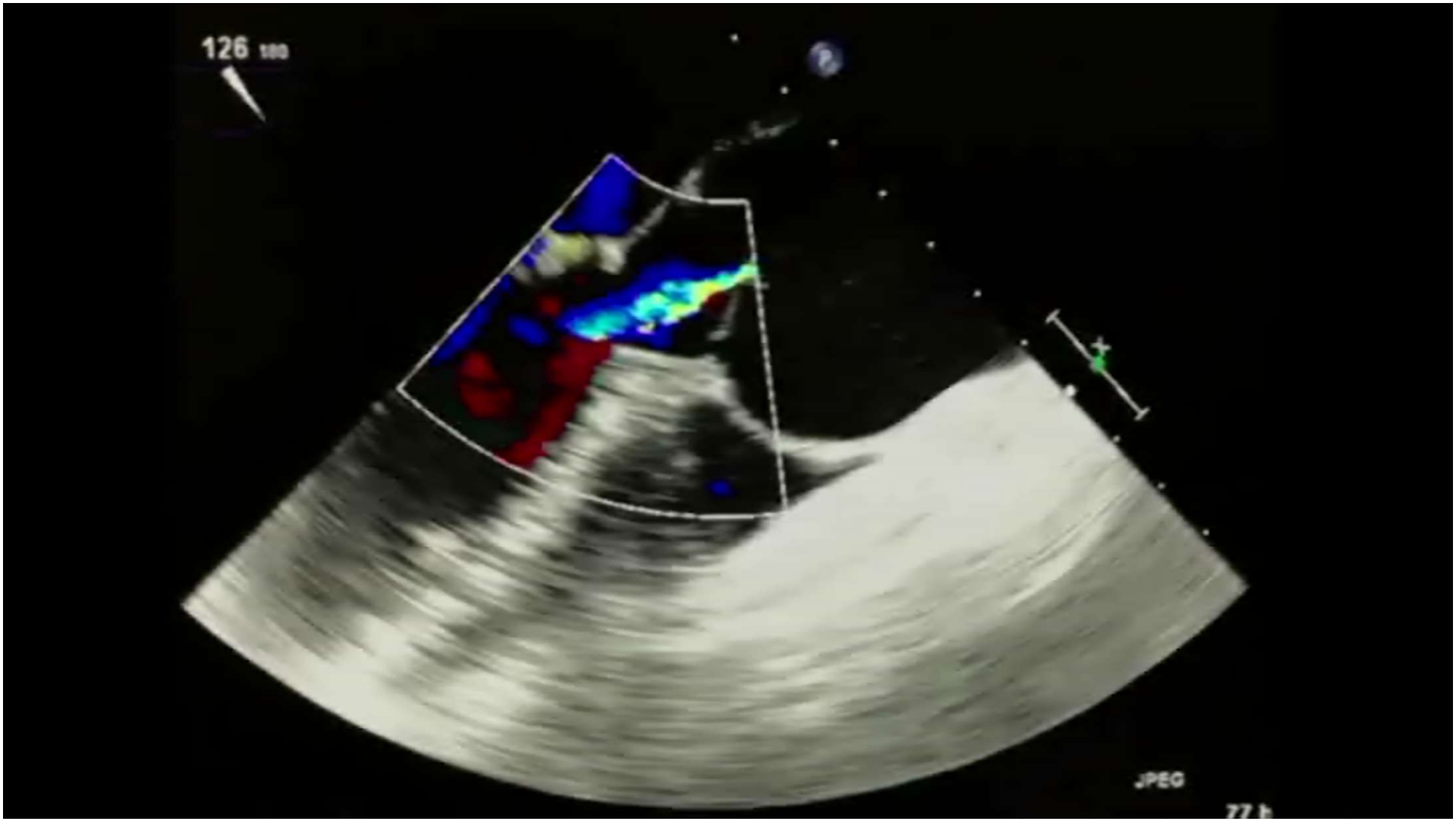
Mini Bentall

Parameter	Mini-Bentall (N = 48)	Full Bentall (N = 49)	*P* value
CPB time, min, median (IQR)	165 (155.5-183)	164 (150-187)	.619
ACC time, min, median (IQR)	139 (128.5-153)	137 (125-156)	.948
RBC, units, median (IQR)	0 (0-1)	0 (0-2)	.435
FFP, units, median (IQR)	0 (0-2)	0 (0-2)	.395
Cryoprecipitate, units, median (IQR)	0.5 (0-2)	0 (0-0)	**.003**
Platelets, units, median (IQR)	1 (0-2)	0 (0-2)	.429

Mini-Valve Sparing

35 yo female

- Marfan syndrome
- Aortic Root Aneurysm
- Mild AI


126
JPEG

Valve Sparing Root Replacement 2008-2024

	Mini (n=22)		Full (n=72)	
Age (SE)	52±2		50±2	
Males	20	91%	65	90%

Exclusion criteria: arch aneurysm

Valve Sparing Root Replacement 2008-2023

	Mini (n=22)		Full (n=59)		P-value
Age	52±10		49±13		0.47
Males	20	91%	53	90%	0.59

Exclusion criteria: arch aneurysm

Plestis, Aorta 2025

Operative Times

	Mini (n=22)	Full (n=59)	P-value
Pump time	204±7	229±6	0.09
Cross Clamp time	174±6	199±5	**0.03**

Plestis, Aorta 2025

Valve Sparing Root Replacement

	Mini (n=22)		Full (n=59)		P-value
Death	0	0%	0	0%	1.0
Stroke	0	0%	1	1.7%	1.0
New RI	0	0%	1	1.7%	1.0
PVS	2	9%	8	14%	0.28

*RI – Renal Insufficiency
**PVS – Prolonged Ventilatory Support

Valve Sparing Root Replacement

	Mini (n=22)		Full (n=59)		P-value
Bleeding	0	0%	5	8%	0.39
Atrial fibrillation	4	16%	7	12%	0.72
Reintubation	0	0%	0	0%	1.0

Valve Sparing Root Replacement

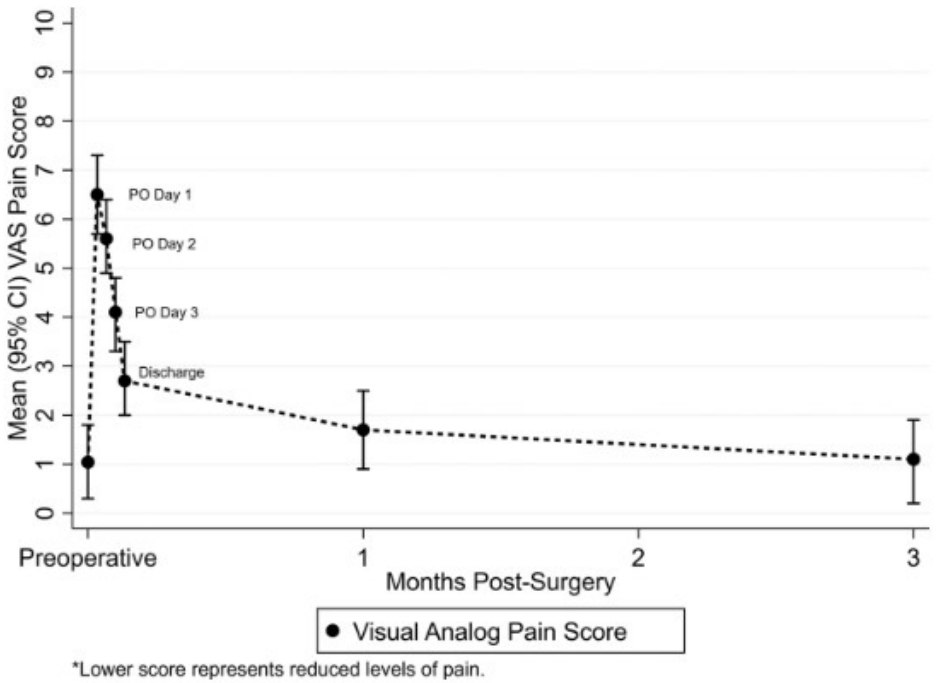
	Mini (n=22)	Full (n=59)	P-value
PRBC	0(0-0)	0(0-2)	0.23
FFP	0 (0-2)	2(0-2.5)	0.88
Platelets	1(0-0.17)	1(0-2)	0.84
Cryo	2 (0-4)	0(0-2)	0.76

Valve Sparing Root Replacement :

	Mini (n=22)	Full (n=59)	P-value
ICU days	3 (2-4)	4 (2-5)	0.09
Hospital stay days	6(6-7)	7(6-11)	0.08

Post Operative Pain

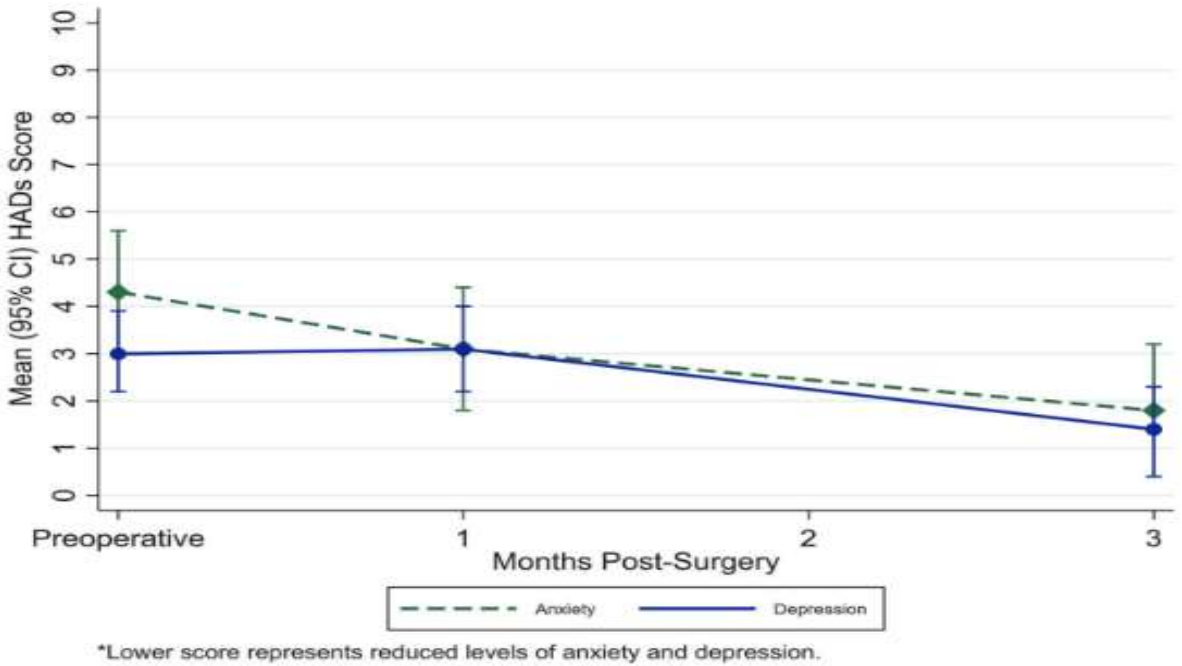
Visual Analog Scale (VAS) scores pain post operatively 1 and 3 Months



Plestis,J Card Surg, 2021

HADS

Hospital Anxiety and Depression Scale (HADS) measuring pre and post operative levels

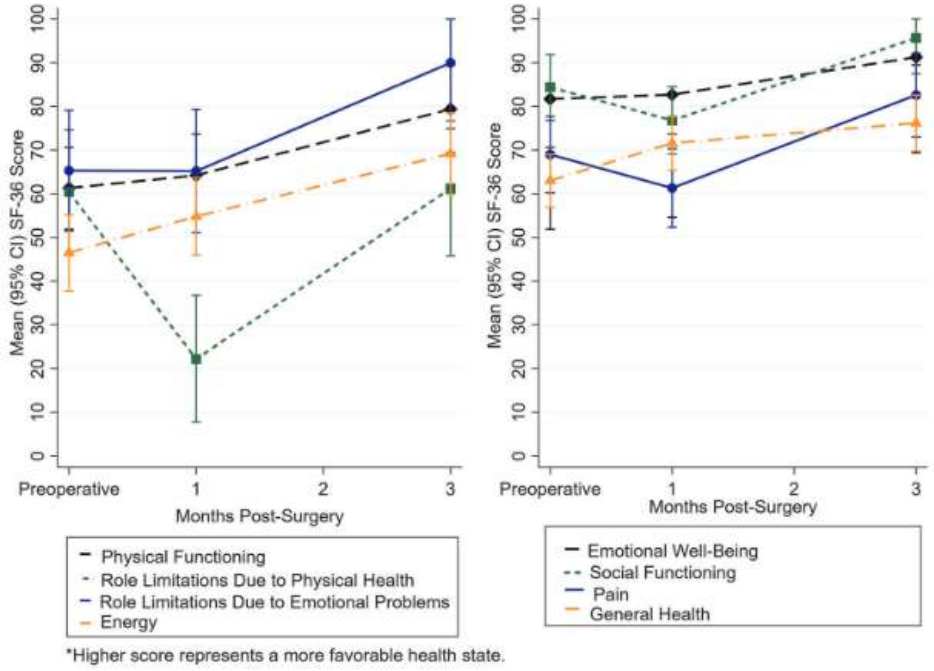


*Lower score represents reduced levels of anxiety and depression.

Plestis, Journal Card Surg,2021

Quality of Life

SF-36 Scores preoperative and at 1 and 3 months post operative



*Higher score represents a more favorable health state.

Plestis, Journal Card Surg,2021

Conclusion

- Minimally Invasive Proximal Aortic Surgery is feasible amongst experienced surgeons
- Intraoperative and postoperative outcomes appear to be comparable to full sternotomy in several recent series
- Long term outcomes are necessary to facilitate a wider adoption of this operation
- Significant impact in pain, anxiety and depression and quality of life after surgery

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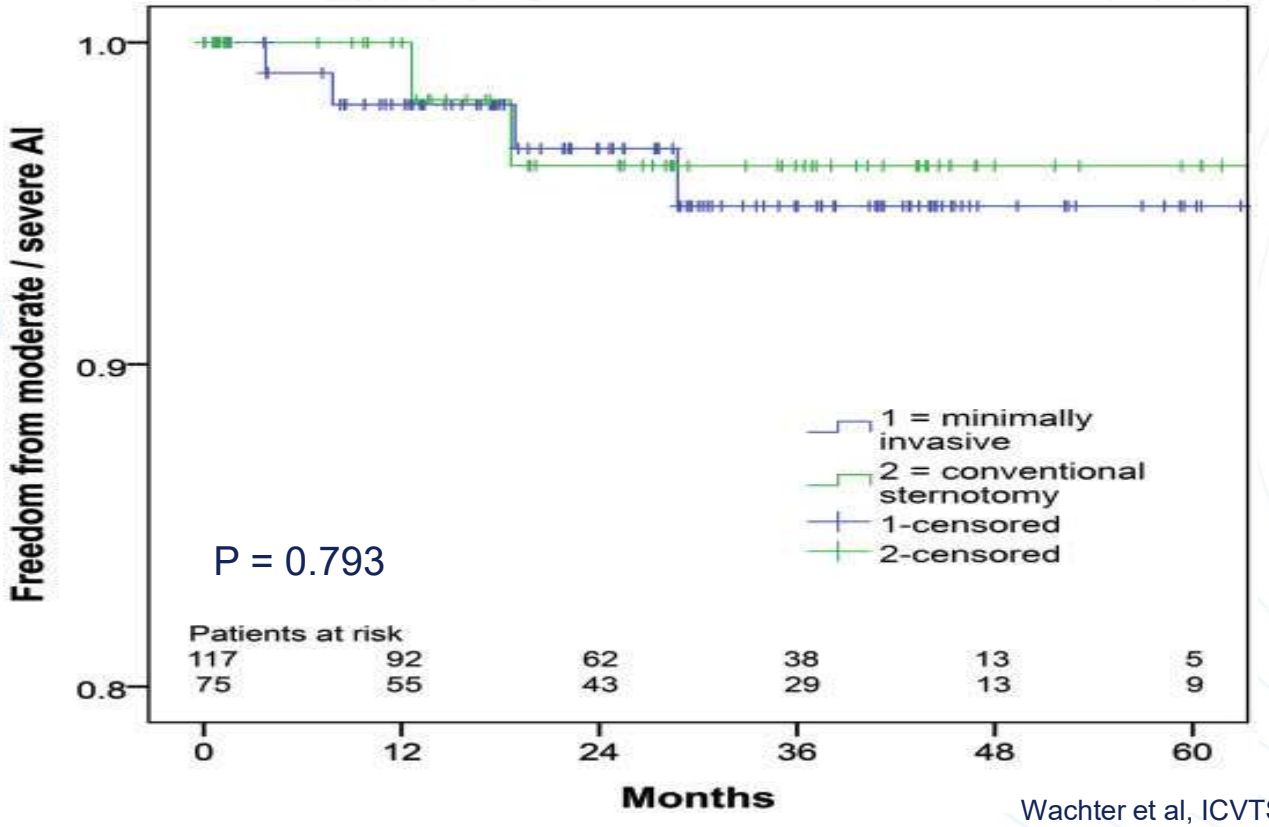
Freedom Of Moderate or Severe Aortic Insufficiency

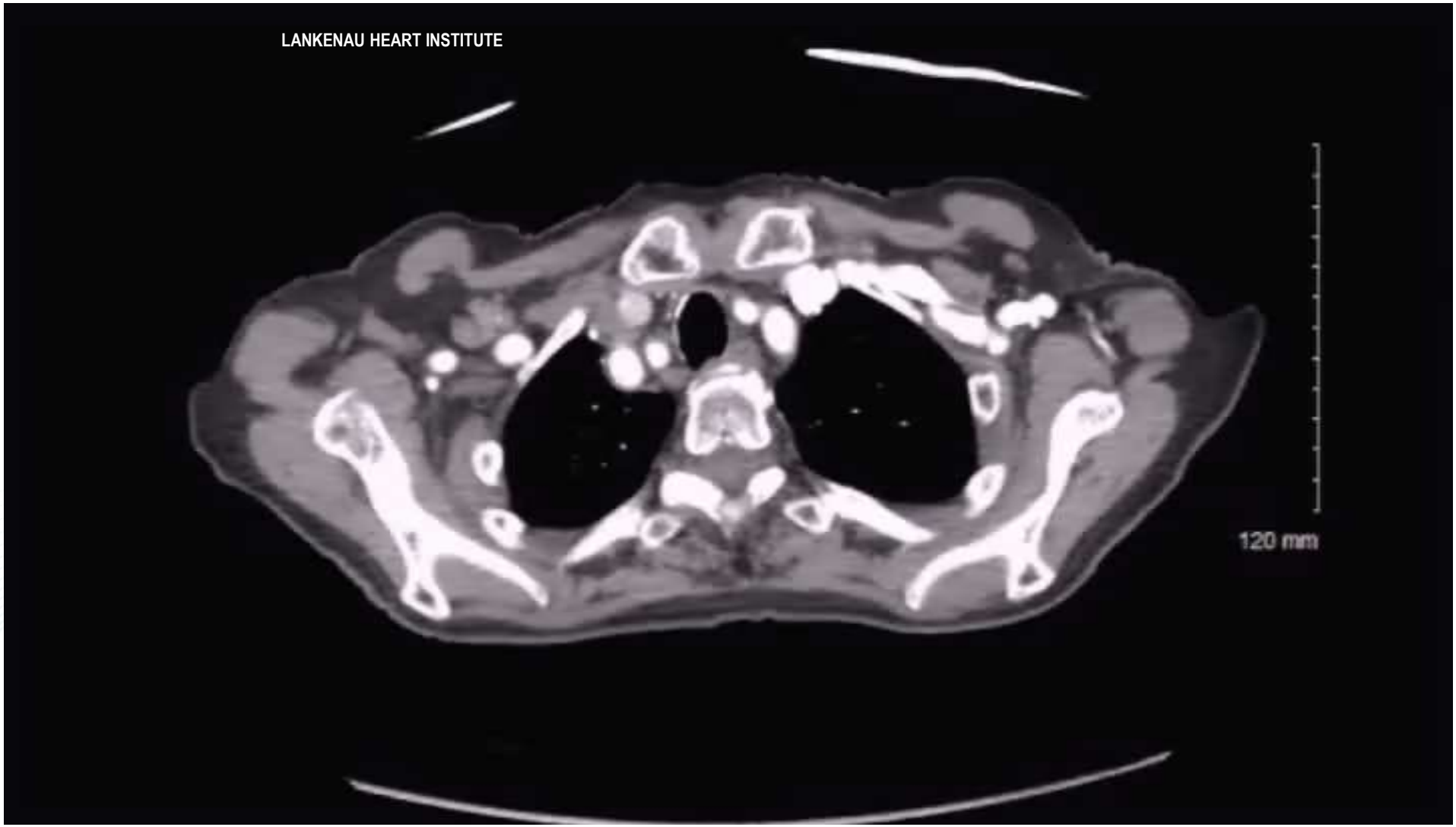


Wachter et al, ICVTS, 2016

Case Presentation
Mini Approach in Hemiarch Aneurysm Resection

70 yo female

- Moderate AI
- Ascending And Arch Aneurysm


LANKENAU HEART INSTITUTE
120 mm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46 bpm

Procedure

- Subcomissural annuloplasty between RC and NC, LC and NC
- Ascending Aneurysm Replacement
- Aortic Arch repair via *bevel* technique

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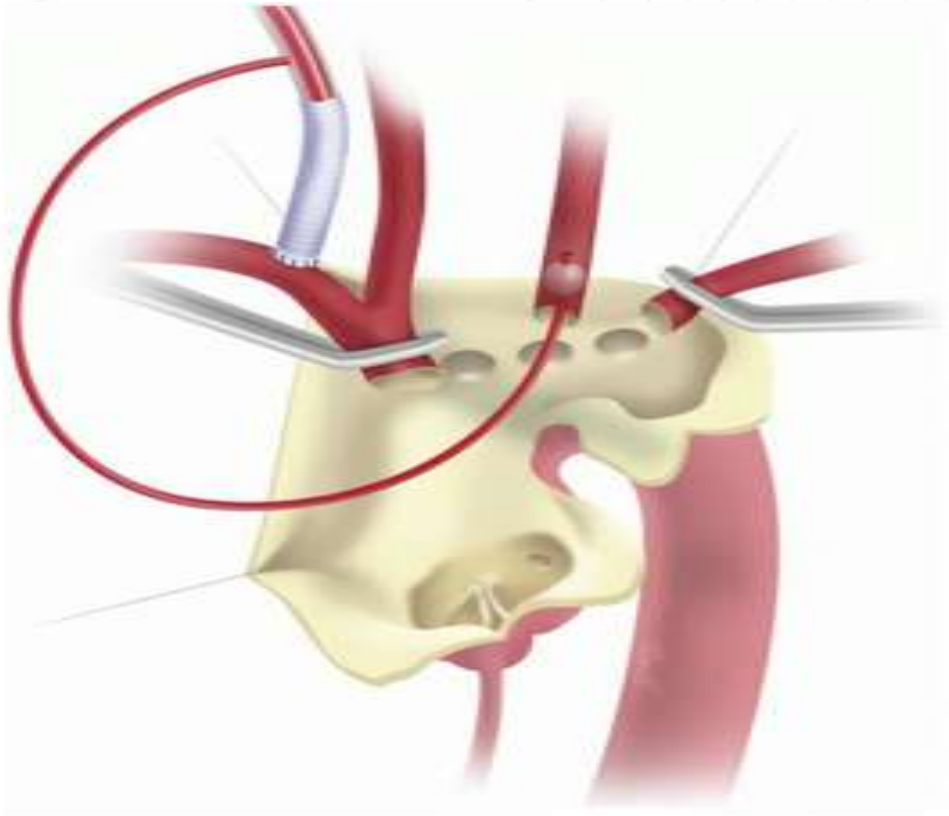


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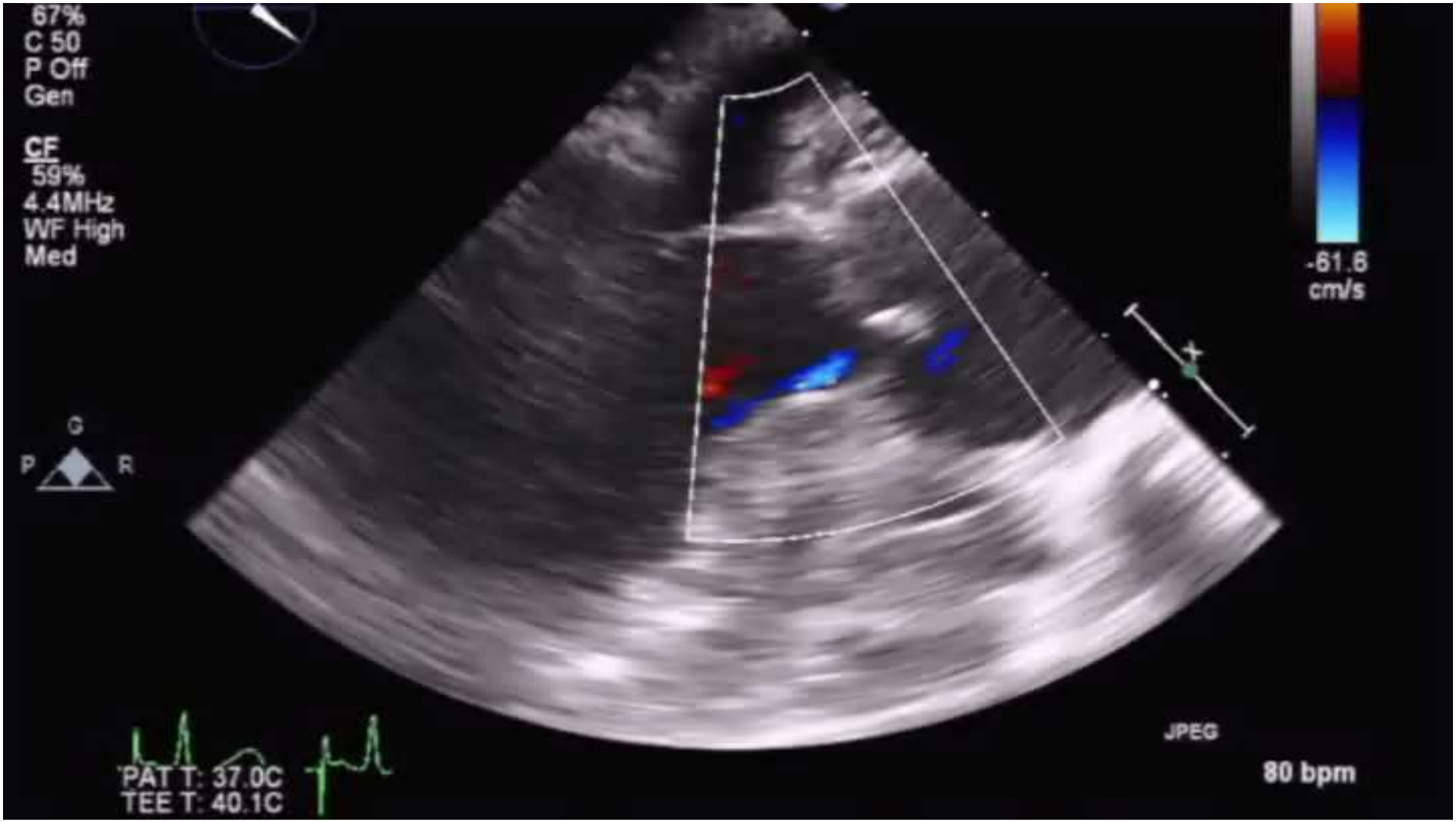
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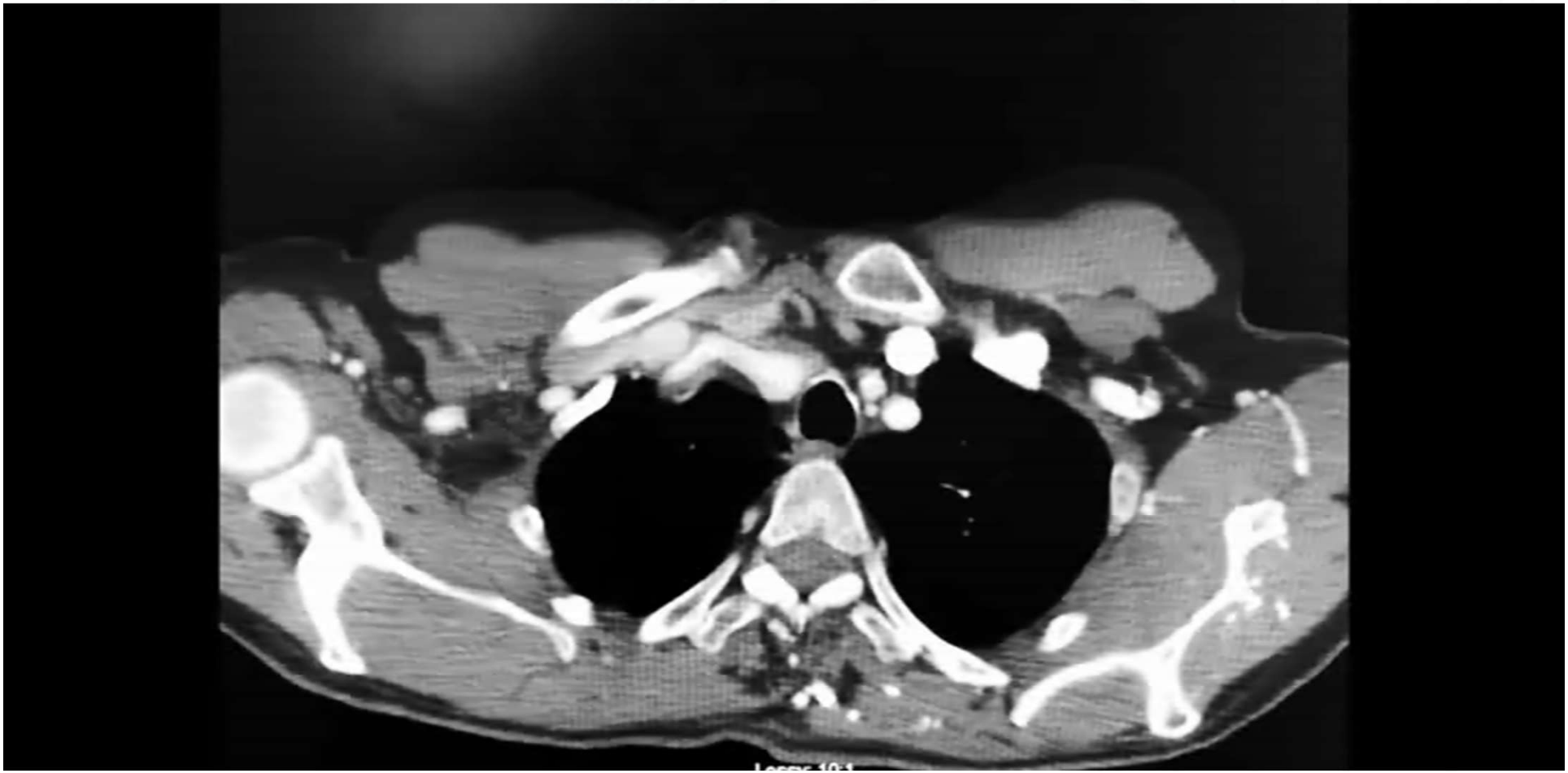
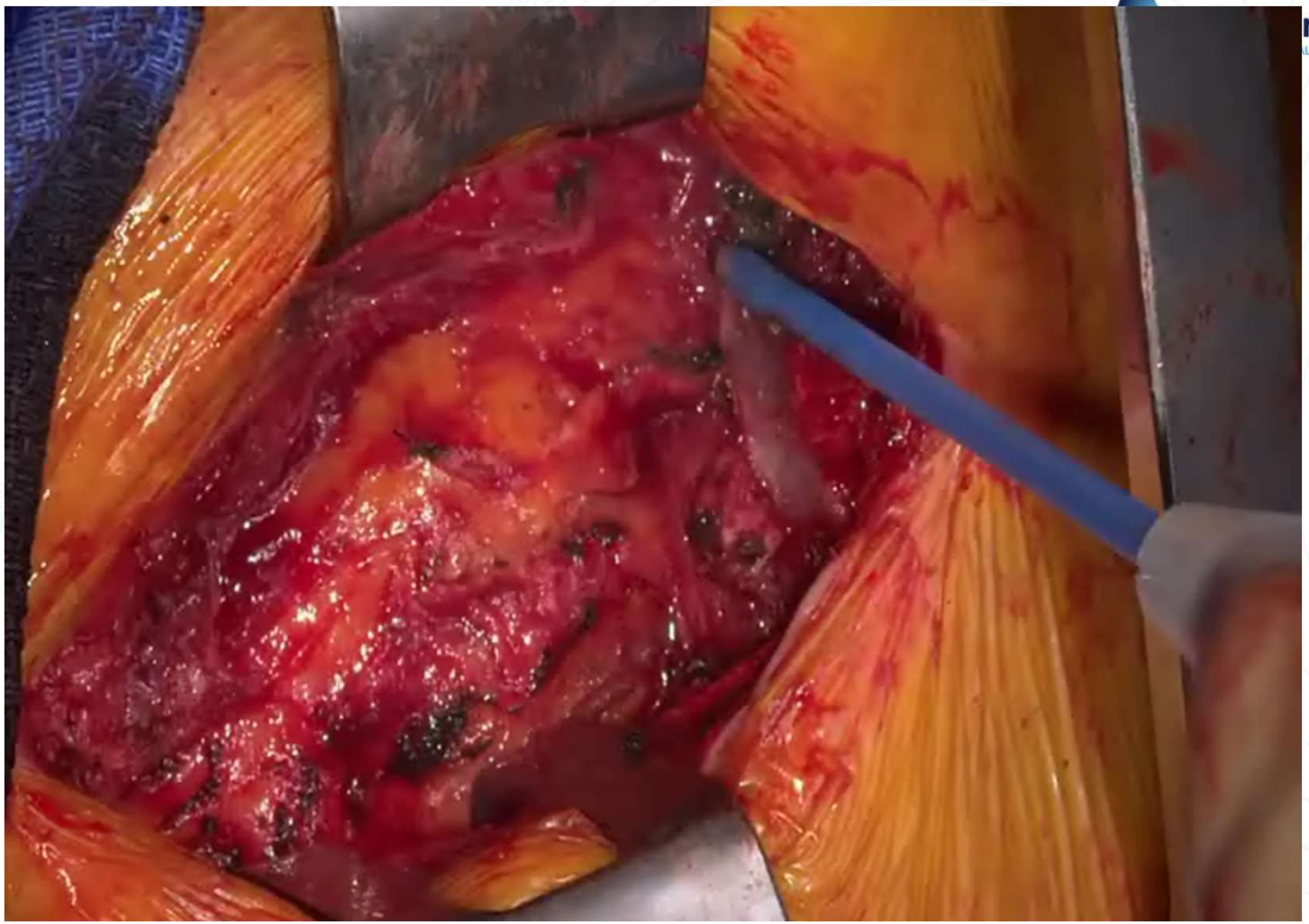
Case Presentation
Redo Ascending Aortic Aneurysm Replacement

65 yo male

- s/p AVR
- Ascending aortic aneurysm





Mini Elephant Trunk Procedure

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70 yo female

- Chest Pain
- SOB

Preoperative diagnosis

- Ascending aortic aneurysm
- Aortic arch aneurysm
- Descending thoracic aortic aneurysm
- Aortic valve regurgitation

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Conclusion

- Minimally Invasive Ascending Aortic Surgery is feasible amongst experienced surgeons
- Intraoperative and postoperative outcomes appear to be comparable to full sternotomy in several recent series
- Long term outcomes are necessary to facilitate a wider adoption of this operation

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Thank you

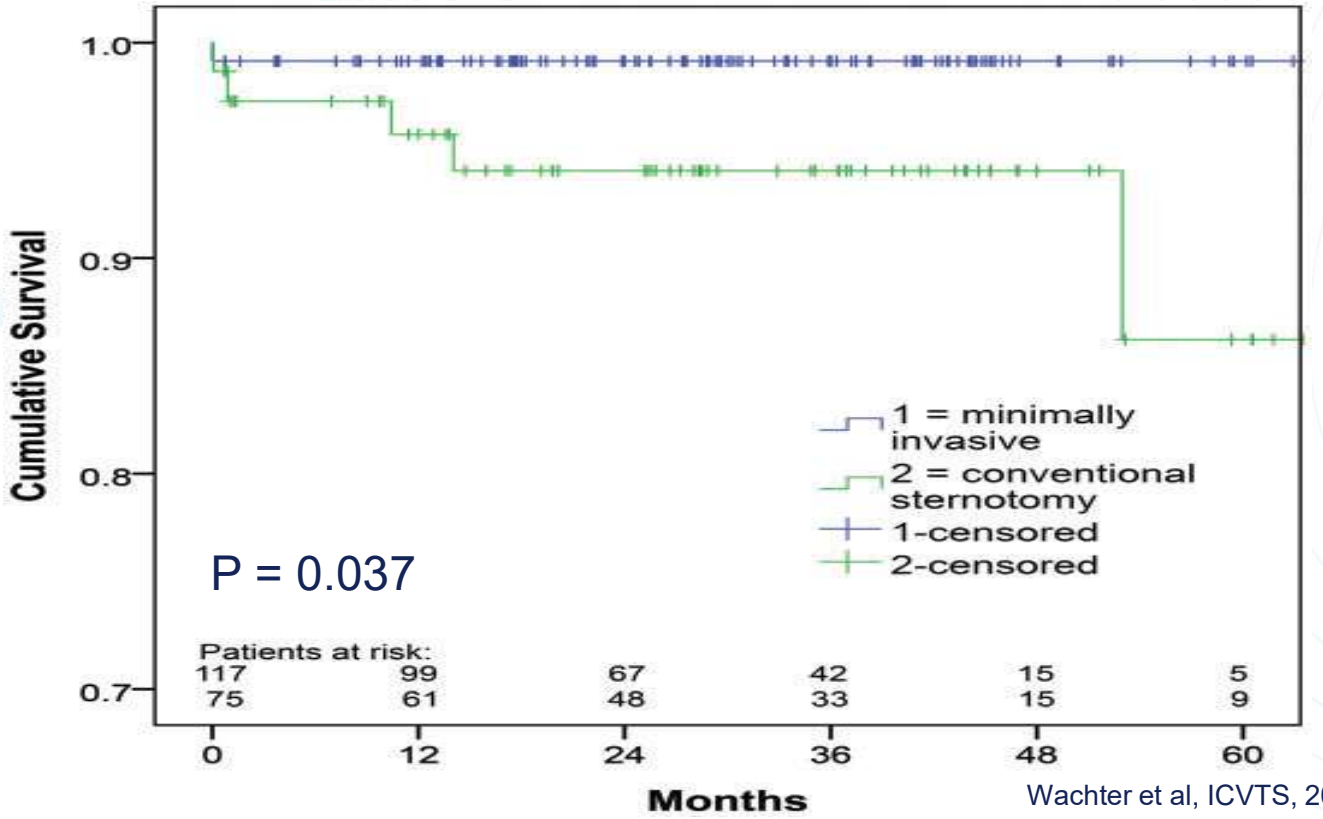
PMH

- Hypertension
- COPD
- Thoracic Aortic Aneurysm

Procedure

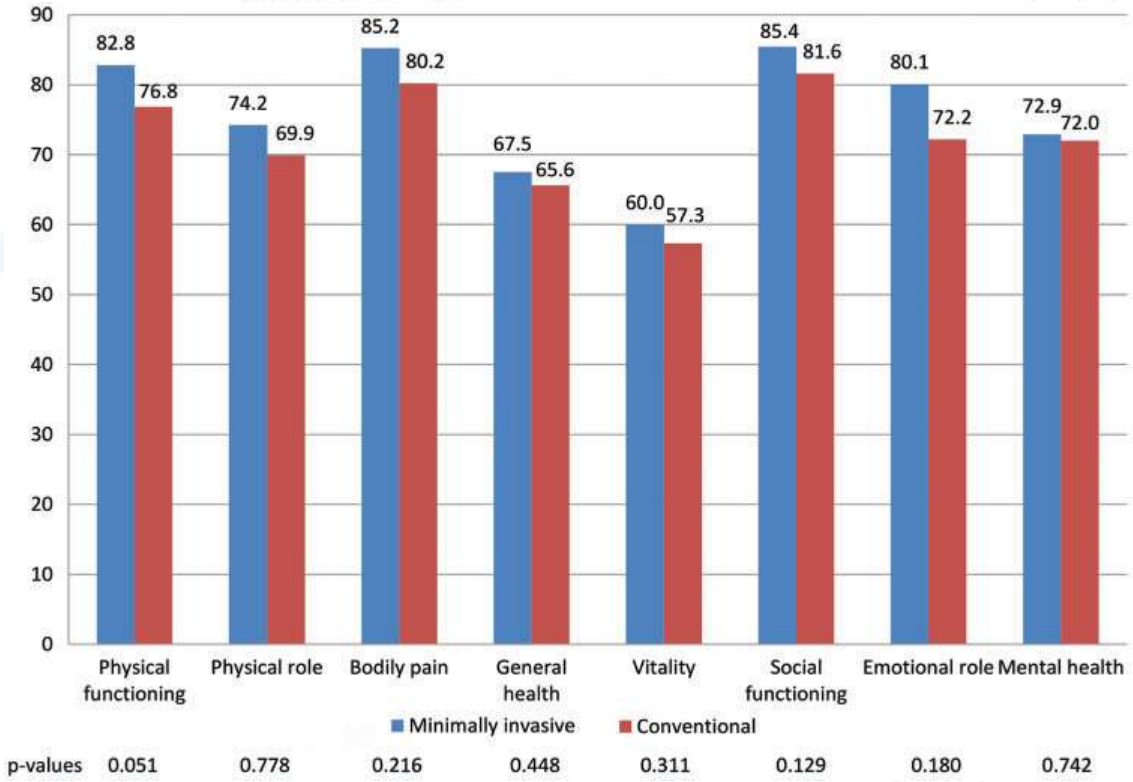
- Mini-Sternotomy
- Aortic Valve Repair
  - Subcommissural annuloplasty – LC-NC
- Ascending Aorta Replacement
- ET stage 1 procedure
- Trifurcation Graft
- DHCA
- ACP

Survival



Wachter et al, ICVTS, 2016

Quality of life



Wachter et al, ICVTS, 2016

Conclusion

- Intraoperative and postoperative outcomes comparable to full sternotomy
- Upper ministernotomy is feasible for Bentall procedures amongst experienced surgeons

Case Presentation

62 yo male

s/p AVrepair- 1960

s/p AVR- 1990

Ascending aortic aneurysm

Literature Review

AORTIC WELLNESS CENTER

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Aortic Root: Patient Demographics

	Sternotomy	
	Mini (n=26)	**Full** (n=91)
Age (Mean ± SD)	57±12	57±13
Males (%)	23 (89)	74 (81)

AORTIC WELLNESS CENTER

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Aortic Root: Operative Times

	Sternotomy	
	Mini	**Full**
Pump time	169 [133-252]	186 [128-302]
Cross Clamp time	148 [113-181]	153 [102-260]
PRBC	0 [0-6]	0 [0-7]

Median [range]

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Aortic Root: Complications

	Sternotomy	
	Mini	**Full**
Death (%)	0 (0)	1 (1)
Stroke (%)	0 (0)	0 (0)
*New RI (%)	0 (1)	1 (2)
**PVS (%)	2 (7.7)	8 (8.8)

*RI – Renal Insufficiency
**PVS – Prolonged Ventilatory Support

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Aortic Root: Hospital stay

	Sternotomy	
	Mini	**Full**
ICU days	3 [1-11]	3 [1-22]
Hospital stay days	6.5 [4-16]	8 [4-35]

Median [range]

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Aortic Root: Complications

	Sternotomy	
	Mini	Full
Bleeding (%)	0 (0)	6 (6.6)
Atrial fibrillation (%)	5 (19.3)	24 (26)
Reintubation (%)	0 (0)	4 (4.4)

Valve Sparing Root Replacement

Etiology

	Mini (n=24)		Full (n=36)		P-value
Medial Degeneration	16	73%	28	79%	0.52
Bicuspid AV	4	17%	2	5%	0.19
Chronic dissection	2	8%	0	0%	**0.09**
Marfan	2	8%	6	16%	0.21

Composite Valve Graft Replacement

Etiology

	Mini (n=32)		Full (n=181)		P-value
Medial Degeneration	17	53%	93	52%	0.91
Bicuspid AV	12	38%	43	24%	0.10
Infection	3	9%	19	10%	0.09
Chronic dissection	0	0%	18	10%	0.09
Pseudoaneurysm	0	0%	8	4%	0.25

Conclusion

- Intraoperative and postoperative outcomes comparable to full sternotomy
- Upper ministernotomy is feasible for Bentall procedures amongst experienced surgeons

Thank you

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Types of Cerebral Injury during Arch Surgery

- Focal embolic
- Diffuse ischemic

Strategies to Minimize Cerebral injury in Arch Surgery

- Minimize Particulate Embolization

  - Axillary cannulation
  - Avoid manipulation of diseased vessels
  - Trifurcation graft
  - Aspirate cerebral vessels prior to resuming cerebral perfusion

Strategies to Minimize Cerebral injury in Arch Surgery

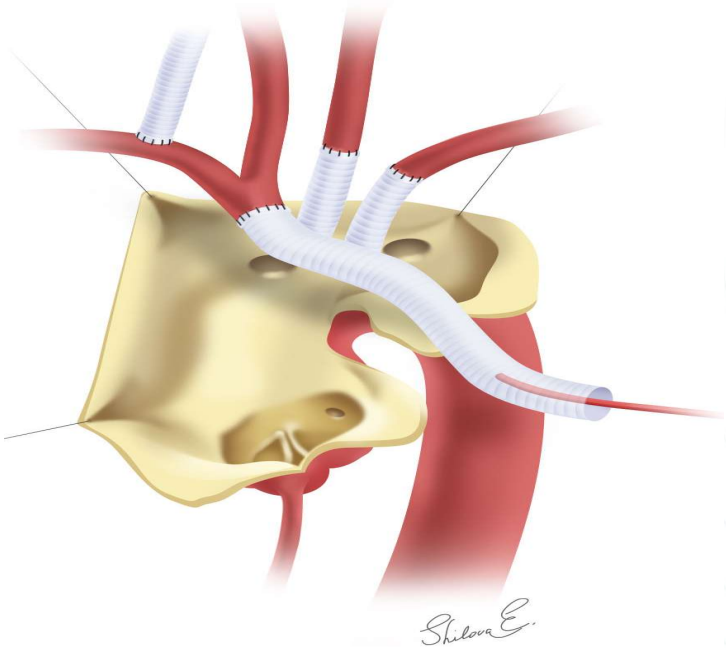
- Trifurcation graft (arch first technique)
- EEG, SSEP, INVUS
- Head packed in ice
- Antegrade selective cerebral perfusion

Optimal Parameters For ACP

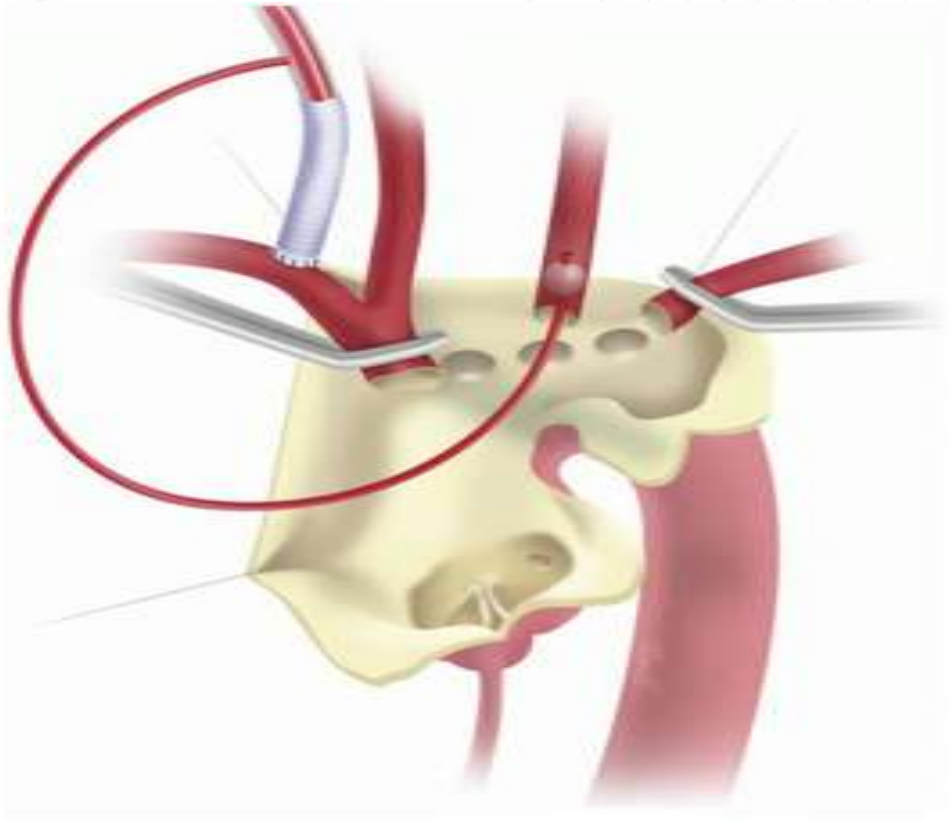
- Temperature: 15°- 20°C
- Pressure: 50-70 torr
- pH management: Alpha stat
- Haematocrit: 30%

Surgical Strategy

- Median/mini sternotomy
- Axillary cannulation
- Right atrium cannulation
- Hypothermic Circulatory Arrest at 20 -24°C



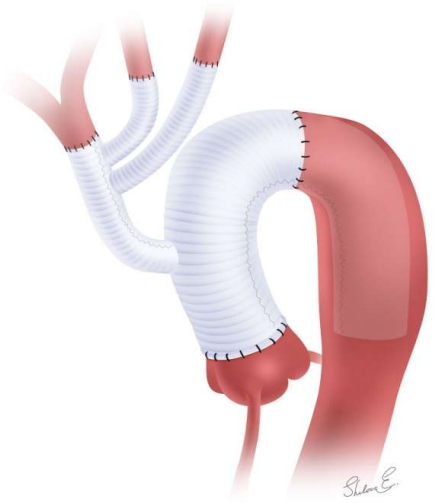
ACP



Surgical Strategy

- Trifurcation graft to innominate, left carotid and left subclavian artery

- Antegrade selective cerebral perfusion



Case Presentation
Mini Elephant Trunk Procedure

70 yo female

- Chest Pain
- SOB
- Hypertension
- COPD

Case Presentation

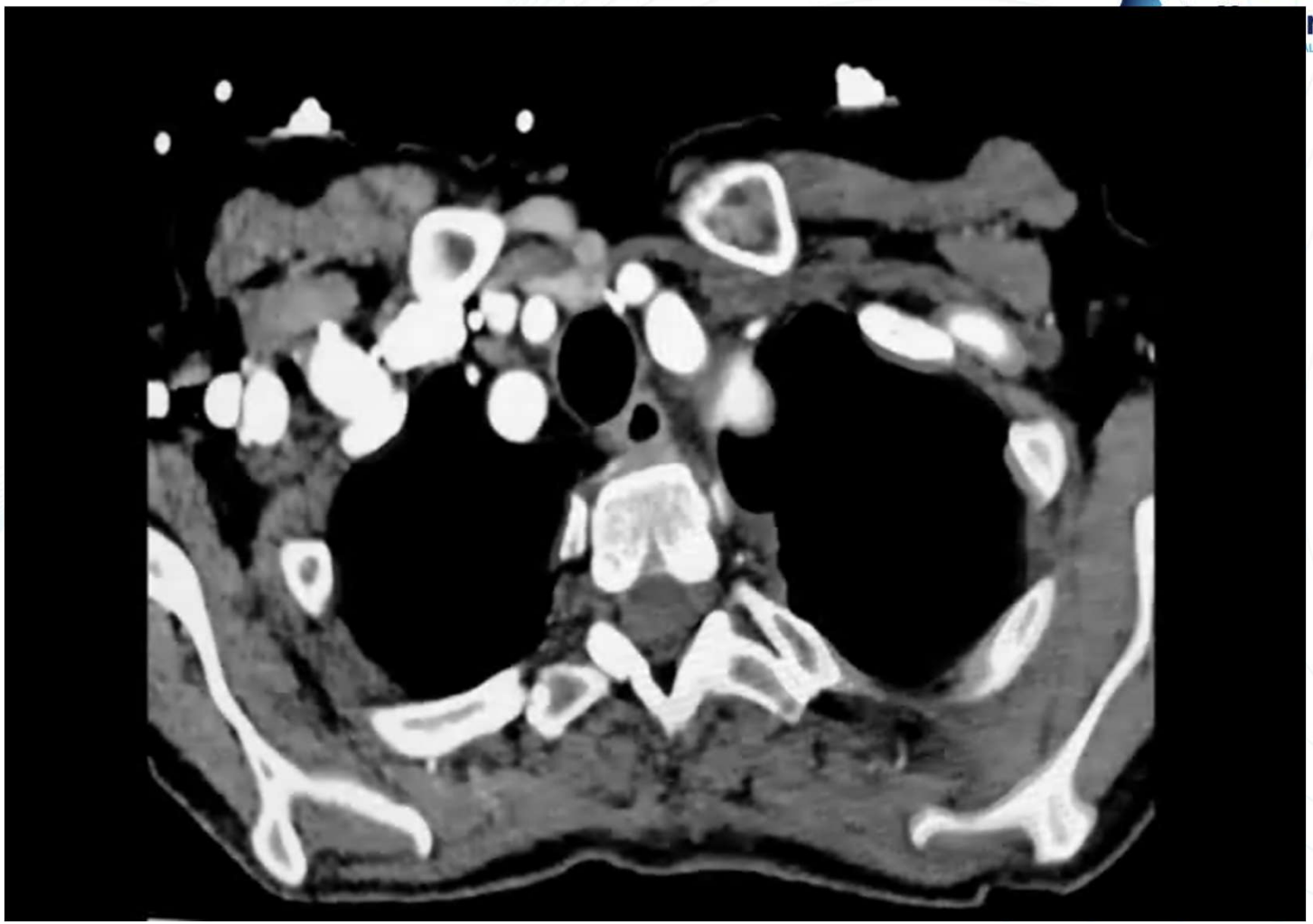
- Ascending aortic aneurysm
- Aortic arch aneurysm
- Descending thoracic aortic aneurysm
- Aortic valve regurgitation

Surgical Strategy

- Partial sternotomy
- Right subclavian artery cannulation
- Right femoral vein cannulation
- Deep Hypothermic Circulatory Arrest at 20° C
- Antegrade cerebral perfusion

Procedure

- Trifurcation Graft
- ET stage 1 procedure
- Ascending Aorta Replacement
- Aortic Valve Repair
    - Subcomissural annuloplasty – LC-NC



Aortic Arch Replacement

- Open surgical repair
- Cardiopulmonary bypass (CPB)
- Deep Hypothermic Circulatory Arrest (DHCA)
- Older patients
- Multiple comorbidities

Hybrid Aortic Arch Replacement

- Debranching of aortic arch vessels
- Reimplantation of arch vessels to the ascending aorta
- Long proximal landing zone
- TEVAR

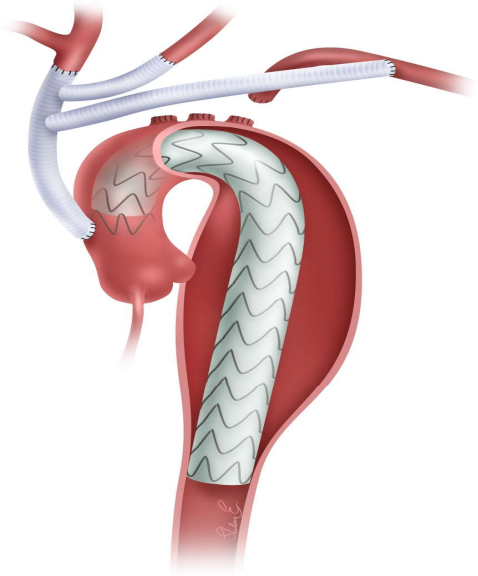
Type I Hybrid Arch Repair

- Total arch debranching
- TEVAR extending to Zone 0
- No ascending aorta replacement
- No CPB and Aortic cross-clamping (majority of cases)
- CPB ± aortic cross-clamping for very proximal anastomosis

Type II Hybrid Arch Repair

- Aneurysmal ascending aorta
- Replacement of ascending aorta with a Dacron graft
- Aortic arch debranching (CPB without cross clamping)
- TEVAR (antegrade ± retrograde)

Debranching Options



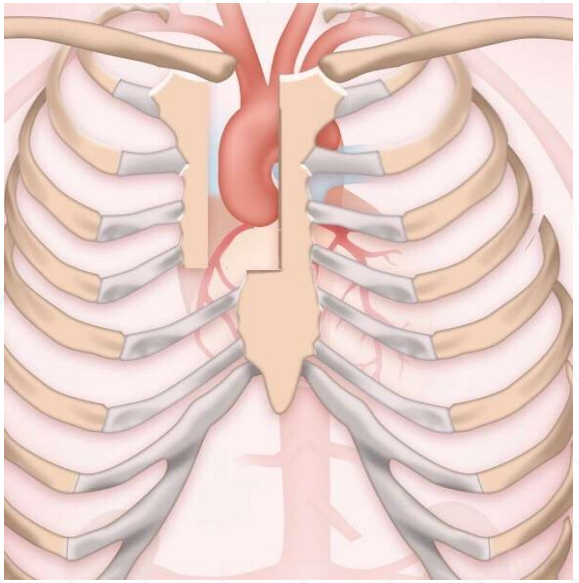
Case Presentation

55 yo male

- Severe back pain
- Subacute type B aortic dissection

CT Findings

- True lumen compressed by false lumen
- Extension into aortic arch

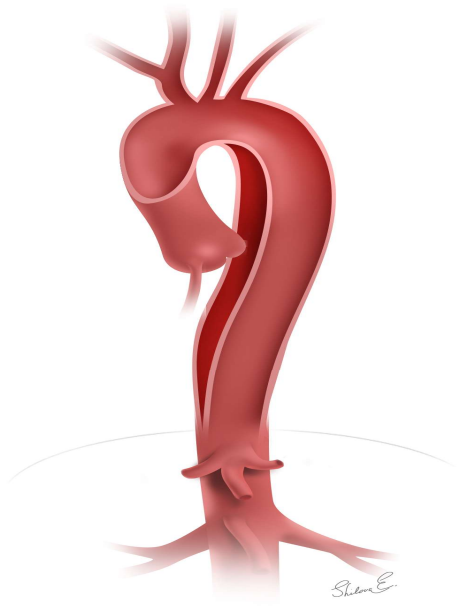


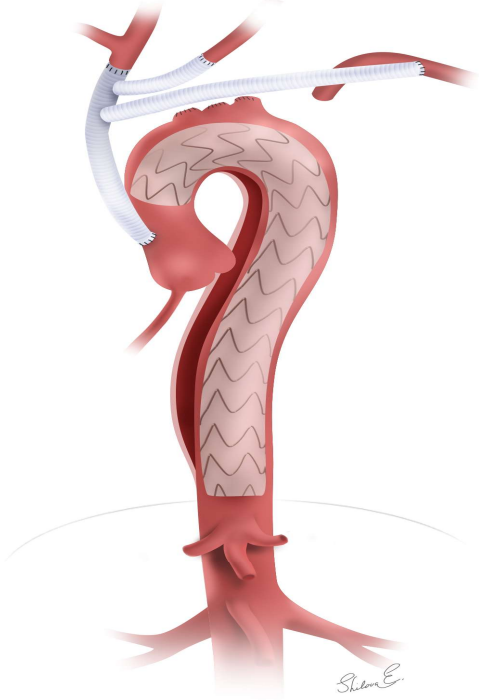
Case Presentation

55 yo male

- Chest Pain
- Back Pain

Procedure





Case Presentation

- **78 yo male**
- Aortic Arch Aneurysm

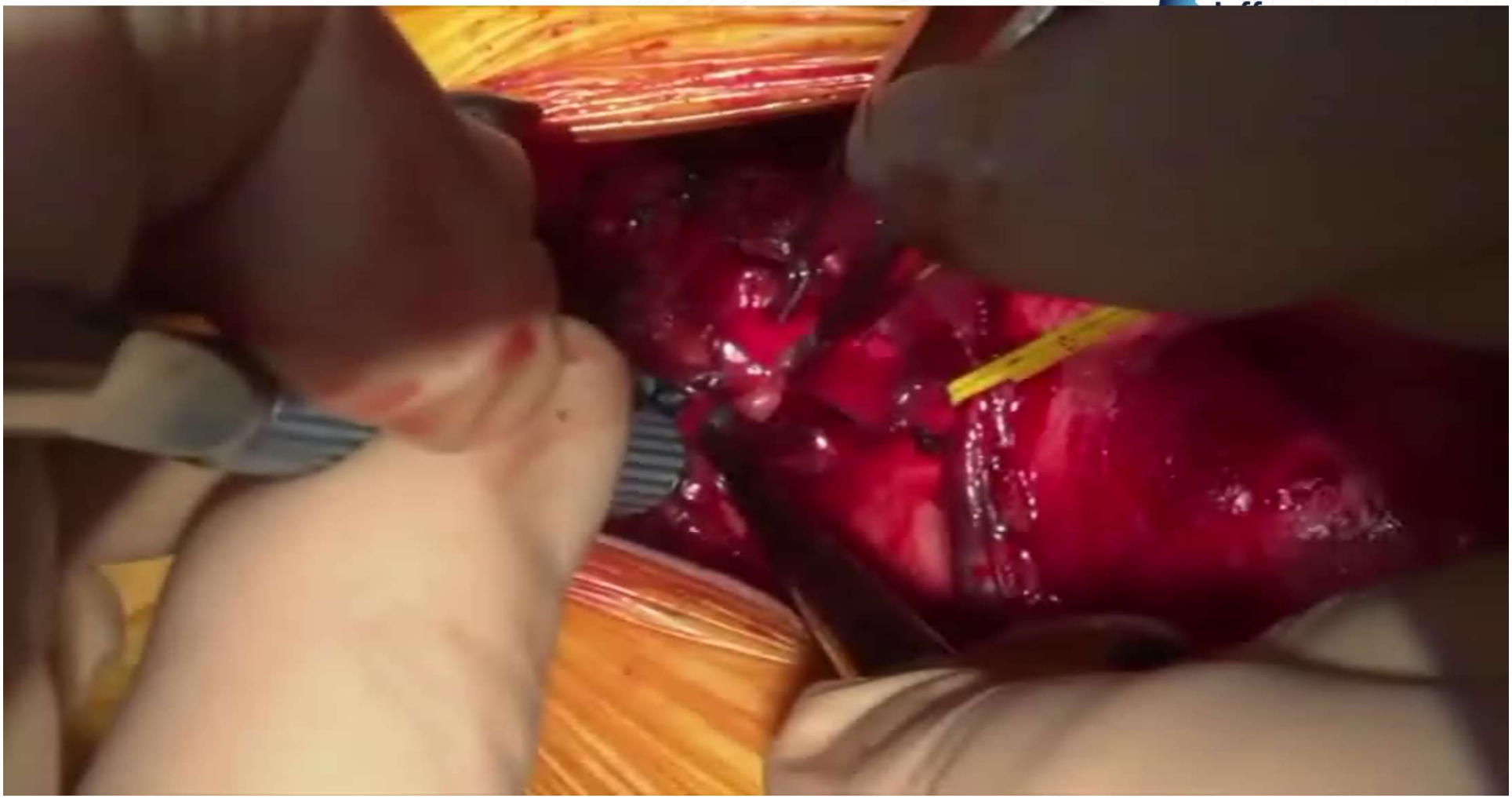
Procedure

- Aortic Arch Debranching (trifurcation graft)

- Bypass to:
  - Brachiocephalic
  - Left Carotid
  - Left Subclavian

- TEVAR from zone 0 to mid-descending thoracic aorta

Procedure



Procedure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512
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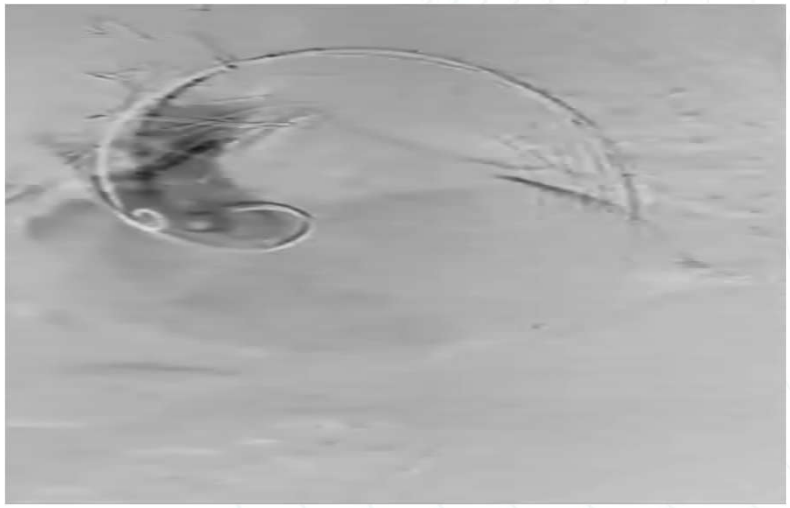
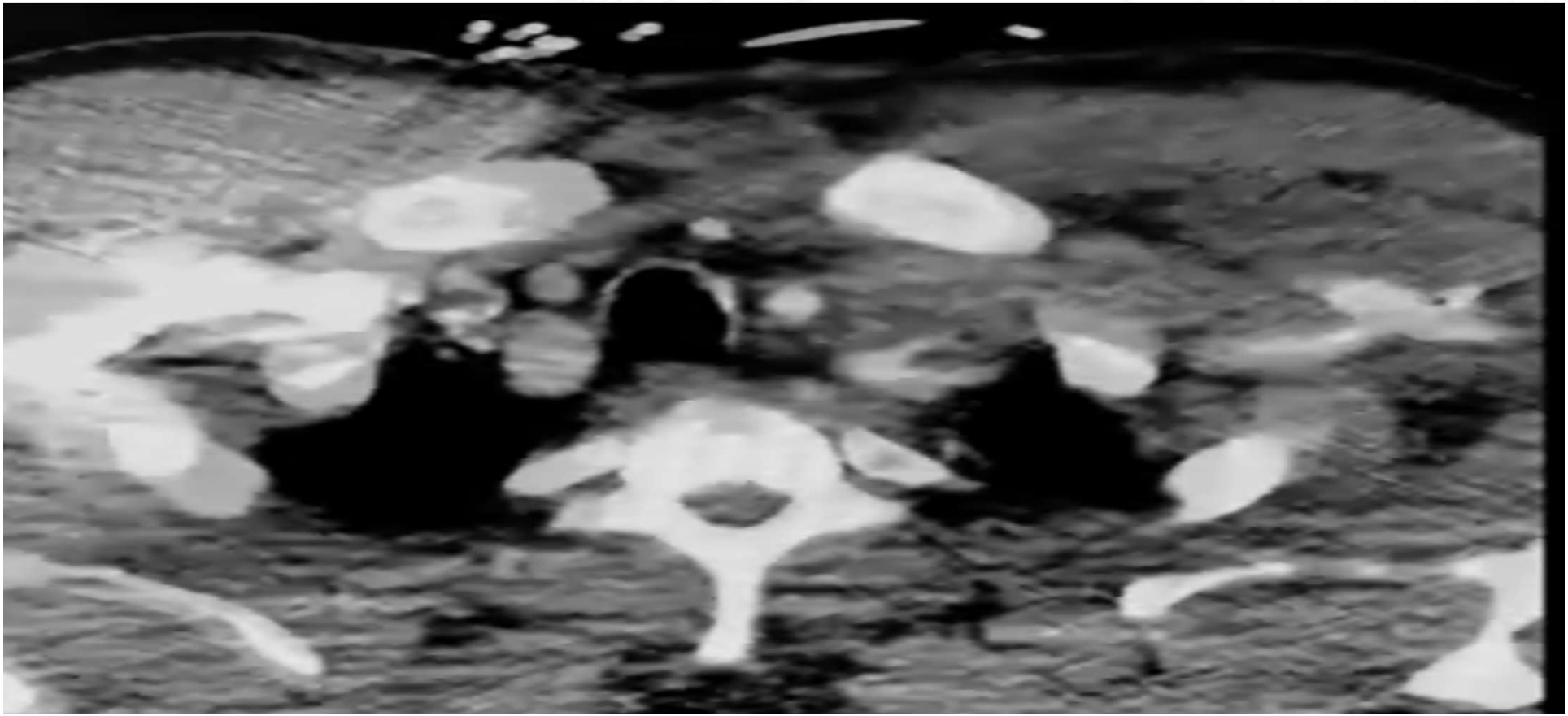
Stent Placement

Pre-endograft placement



Post-endograft placement

Follow-up CT



Conclusions

- Total Aortic Arch replacement with the use of trifurcation graft has led to simplification of the technical aspects of the operation
- The technique is very versatile and can be used in all the anatomical circumstances
- Minimally invasive techniques can be used in arch surgery
- Surgical experience in arch surgery and minimally invasive techniques is important.

Conclusion

- Minimally Invasive Aortic Arch Surgery is feasible amongst experienced surgeons
- Intraoperative and postoperative outcomes appear to be comparable to full sternotomy
- Long term outcomes are necessary to facilitate a wider adoption of this operation

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Thank You

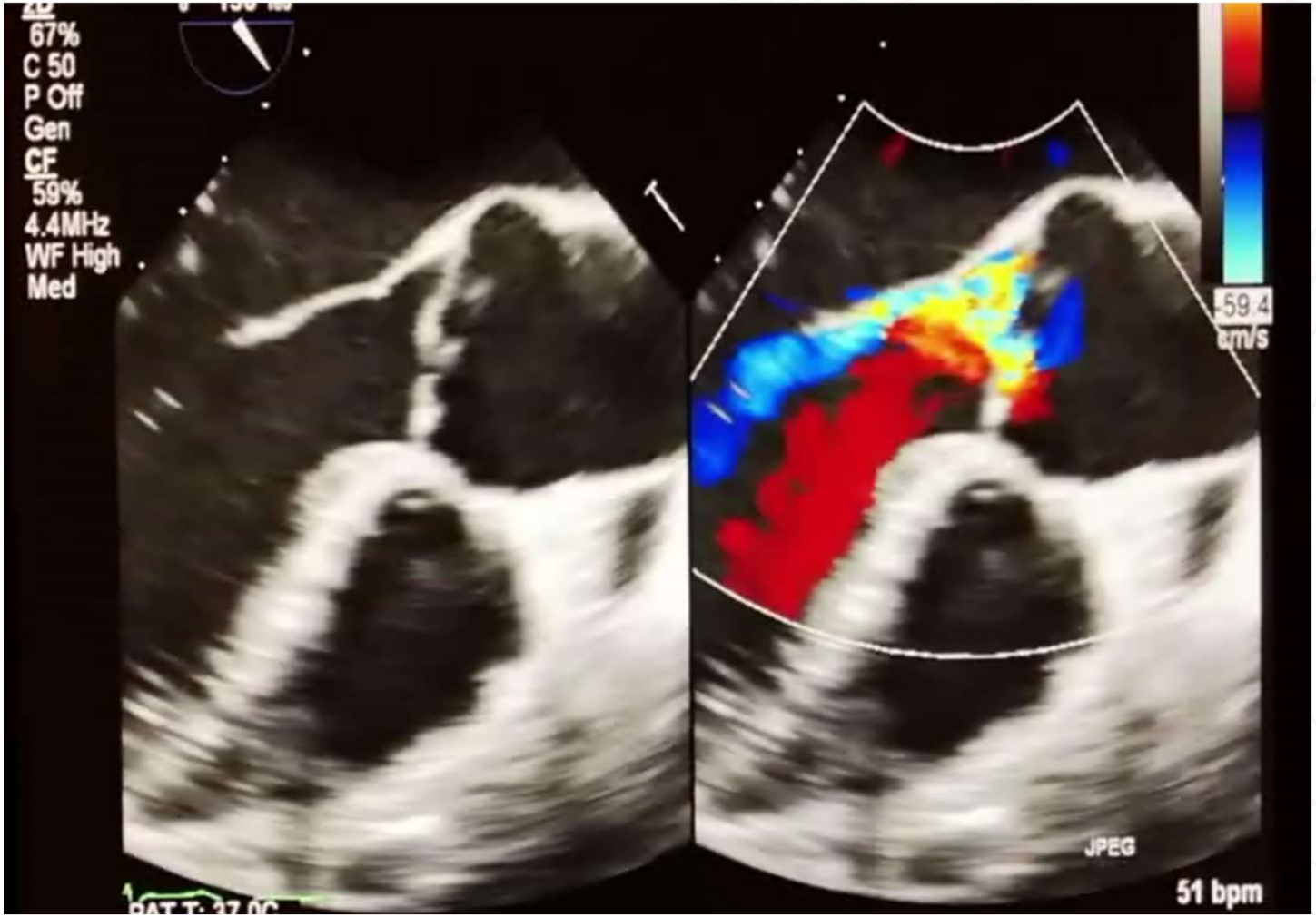
Bicuspid Aortic Valve Repair

65 yo male

- Bicuspid Aortic Valve
- Severe Aortic Regurgitation

Procedure

- J- type partial sternotomy with extension into the 3rd right intercostal space
- Exertion of 29 Taylor annuloplasty ring in the aorto-ventricular junction
- Free edge plication of the left coronary cusp and conjoined right and non-coronary cusp
- Establishing sino-tubular junction to 31 mm with a band.


67%
C 50
P Off
Gen
CF
59%
4.4MHz
WF High
Med
-59.4
cm/s
JPEG
51 bpm

Conclusion

- Intraoperative and postoperative outcomes comparable to full sternotomy
- Upper ministernotomy is feasible for Bentall procedures amongst experienced surgeons

Conclusions

Mini hybrid approach

Provides excellent exposure to arch and ascending aorta

Allows simultaneous arch and descending aorta repair

Avoid cardiopulmonary bypass and DHCA in most cases

Provides excellent outcomes in high risk patients with a variety of arch and descending pathology

Thank You

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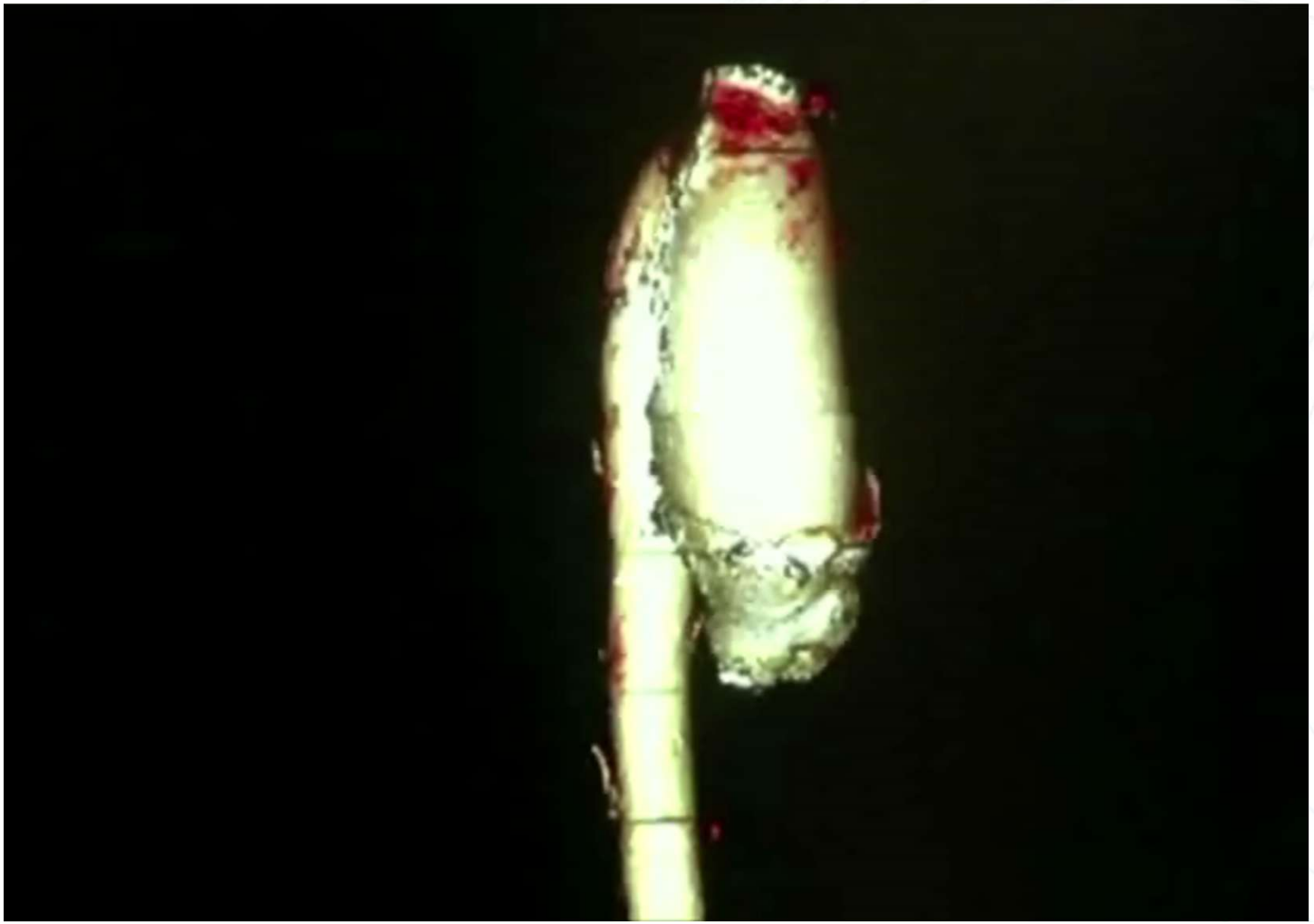
Ascending Aorta Repair ± AVR

31 yo female

- Asymptomatic
- Severe AI
- Bicuspid AV
- Ascending Aortic Aneurysm



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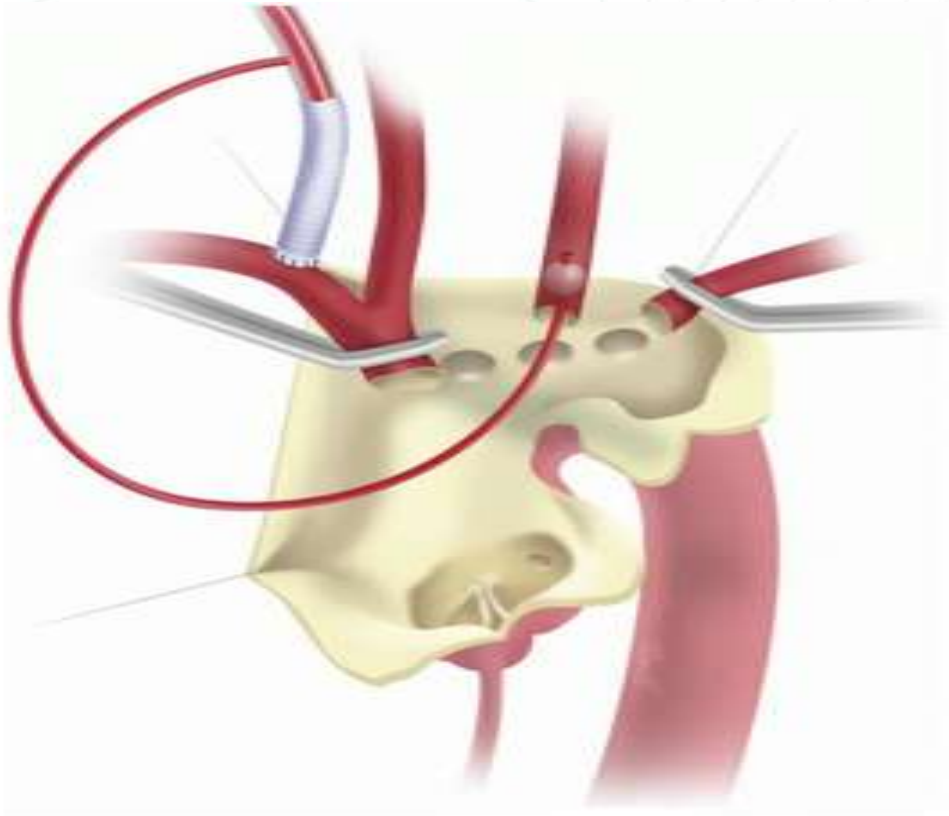

Conclusions

- Total Aortic Arch replacement with the use of trifurcation graft has led to simplification of the technical aspects of the operation
- The technique is very versatile and can be used in all the anatomical circumstances
- Minimally invasive techniques can be used in arch surgery
- Surgical experience in arch surgery and minimally invasive techniques is important.

Mini Bentall Procedure: Literature Review

	Hillebrand 2016		Del Giglio 2017		Plestis 2016	
	Mini (n=33)	Full (n=25)	Mini (n=53)	Full (n=185)	Mini (n=32)	Full (n=181)
Age	56±13	59 ± 12	61± 13.3	63.5 ± 12	57 ± 13	57±13
Male	73%	72%	83%	79%	85%	81%
Redo	0%	0%	0%	23%	13%	27%

Mini Bentall Procedure Literature Review

	Hillebrand 2016		Del Giglio 2017		Plestis 2016	
	Mini (n=33)	Full (n=25)	Mini (n=53)	Full (n=185)	Mini (n=32)	Full (n=181)
CPB	166 ± 40	162 ± 46	96 ± 34	113 ± 43	169± 25	216 ± 55
CC	122 ± 27	113 ± 23	82 ± 28	94 ± 35	140 ± 19	176 ± 44
PRBC	1.42 ± 2.46	1.3 ± 3.2	4.9 ± 6	6.7 ± 11	1.0±1.5	3.1±5.1

Mini Bentall Procedure Literature Review

	Hillebrand 2016		Del Giglio 2017		Plestis 2016	
	Mini (n=33)	Full (n=25)	Mini (n=53)	Full (n=185)	Mini (n=32)	Full (n=181)
Stroke	3%	0%	N/A	N/A	0%	0.5%
PVS	N/A	N/A	2%	10%	6%	17%
Mortality	3%	4%	0%	4.5%	0%	3.9%
Hospital stay	13.36 ± 9.27	13.5 ± 10.2	10.5 ± 6.4	10.7 ± 7.7	7.7±3.4	11±8.3

Composite Valve Graft Replacement

Etiology

	Mini (n=67)		Full (n=201)	
Medial Degeneration	50	75%	120	60%
Bicuspid AV	26	39%	42	21%
Pseudoaneurysm	2	3%	4	2%
Marfan	0	0%	16	8%

Composite Valve Graft Replacement

	Mini (n=67)		Full (n=201)	
Urgent	0	0%	27	13%
Redo	8	12%	53	26%

David Procedure Literature Review

	Wachter 2016		Shrestha 2014		Plestis 2017	
	Mini (n=177)	Full (n=75)	Mini (n=26)	Full (n=14)	Mini (n=24)	Full (n=36)
Age	56± 13	64 ± 11	47.6±13	64.2±9.5	57 ± 10	48±13
Male (%)	95 (81.2)	52 (69.3)	22 (84.6)	10 (71)	20 (92)	31 (86)
Redo (%)	1 (0.9)	5 (6.7)	N/A	N/A	2 (8)	2 (6)

Comparative Operative Outcomes

	Wachter 2016		Shrestha 2014		Plestis 2016	
	Mini (n=177)	Full (n=75)	Mini (n=53)	Full (n=185)	Mini (n=24)	Full (n=36)
CPB	164± 32	167± 42	175±41	163±24.5	197 ± 39	221 ± 42
CC	131± 21	129± 25	115±30	114±19	166 ± 39	192 ± 34
PRBC	1.5 ± 2.7	4.1 ± 12.8	1.0±1.7	2.1±1.8	0.6±1.6	1.4±2.1

Mean ± SD

Comparative Complications

	Wachter 2016		Shrestha 2014		Plestis 2016	
	Mini (n=177)	Full (n=75)	Mini (n=53)	Full (n=185)	Mini (n=12)	Full (n=36)
Mortality	**0.9%**	**2.7%**	**0%**	**0%**	**0%**	**0%**
Stroke	N/A	N/A	0%	0%	0%	0%
PVS	N/A	N/A	N/A	N/A	3 (25)	4 (12)
Atrial fibrillation	12%	20%	N/A	N/A	16%	12%
Hospital stay Mean ± SD	10.4 ± 5.5	12.9 ± 6.9	10.4±6.8	9.1±2.7	5.8±1.9	7.7±3.6

Ascending Aorta ± AVR

Etiology

	Mini (n=149)		Full (n=152)	
Medial Degeneration	101	68%	88	58%
Bicuspid AV	76	51%	46	30%
Infection	0	0%	5	3%
Chronic Dissection	0	0%	6	4%
Pseudoaneurysm	0	0%	5	3%
Marfan	1	1%	2	1%

Ascending Aorta ± AVR

	Mini (n=149)		Full (n=152)	
Urgent	9	6%	34	19%
Redo	10	7%	27	18%