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Minimally Invasive AVR: Thoracotomy vs. Hemisternotomy

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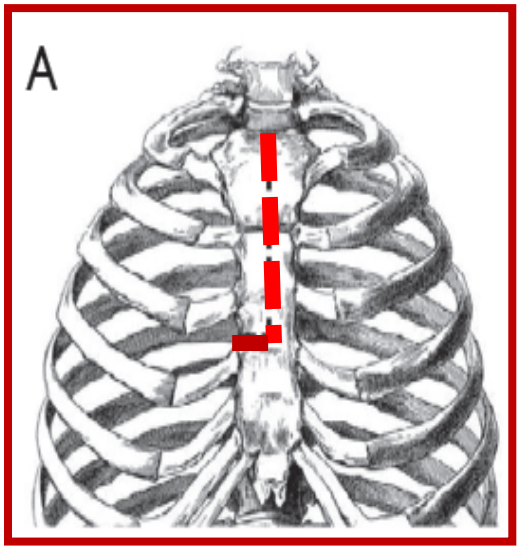
The Society of Thoracic Surgeons

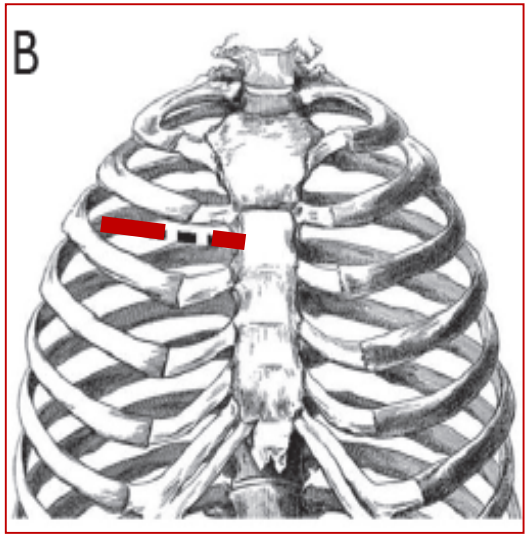
EACTS
European Association For Cardio-Thoracic Surgery

Glauber et al. Minimally invasive aortic valve: present and future.
***Ann Cardiothorac Surg* 2015;4(1):26-32**

MIAVR techniques



Ministernotomy (MS)



Right anterior minithoracotomy (RT)

This approach has now become an established alternative to Full sternotomy (FS) in order to reduce the "invasiveness" of the surgical procedure, while maintaining the same efficacy, quality and safety of a conventional approach.

Minimally Invasive AVR:

- Reduced bleeding
- Pain
- Less wound Infection
- Length of postoperative stay

MIAVR has been shown to reduce postoperative mortality and morbidity

- **Providing faster recovery**
- **Improved patient satisfaction**
- **Better cosmetics results**
- **Requires less rehabilitations resources**
- **Cost are reduction**

Borger et al . MIS-RDAVR in a RANDOMIZED TRIAL.
Ann Thorac Surg 2015;99:17–25
Phan et al. Network meta-analysis of ministernotomy vs. Minithoracotomy.
Ann Cardiothorac Surg 2015;4(1):3-14
Glauber et al. Minimally invasive aortic valve: present and future.
Ann Cardiothorac Surg 2015;4(1):26-32

K. Fattouch et al. / Interactive CardioVascular and Thoracic Surgery
Interactive CardioVascular and Thoracic Surgery 23 (2016) 253–258

MIAVR vs Convencional surgery

Improve postoperative respiratory function due

- Preservation of sternum
- Reduction of postoperative pain
- Blood loss and blood transfusions related to the reduction of surgical dissection,
- Facilitating reoperation at a later date, as part of pericardium remains closed.

Glauber et al. Minimally invasive aortic valve: present and future.
***Ann Cardiothorac Surg* 2015;4(1):26-32**

Ministernotomy versus conventional sternotomy for aortic valve replacement: A systematic review and meta-analysis

Morgan L. Brown, MD, Stephen H. McKellar, MD, Thoralf M. Sundt, MD, and Hartzell V. Schaff, MD

The Journal of Thoracic and Cardiovascular Surgery ᶜ March 2009

Results:

26 studies
4586 patients with AVR
***2054 ministernotomy (MS)**
***2532 full sternotomy (FS)**

There was no difference in mortality (OR 0.71, 95% CI 0.49–1.02).
Not found to be significantly different after testing for interaction (P= .8)

Ministernotomy	Weighted mean	95% CI
Longer cross clamp		
Longer Bypass times		
Shorter ventilation time	2.1 hours	2.95 to 1.30 hours
Less blood loss within 24 hours	79 mL	23 to 136 mL
Shorter Intensive care unit	0.46 days	0.72 to 0.20 days
Shorter Hospital stays	0.91 days	1.45 to 0.37 days

Conclusion: Ministernotomy can be performed safely for aortic valve replacement, without increased risk of death or other major complication

Randomized studies** **emonstrate no** **e between** **tomy and full** **sternotomy.

Rate of conversion from partial to conventional sternotomy was 3.0% (95% CI 1.8%–.4%).

Minimal Access Aortic Valve Replacement: Is It Worth It?

Bari Murtuza, PhD, FRCS, John R. Pepper, FRCS, Rex DeL Stanbridge, FRCS, Catherine Jones, BSc, MBBS, Christopher Rao, MBBS, Ara Darzi, KBE, FRCS, and Thanos Athanasiou, PhD, FETCS

Ann Thorac Surg 2008 Mar;85(3):1121-31.

Meta-analysis of 4,667 patients undergoing any MIAVR approach

Reported benefits in perioperative mortality
OR 0.72; 95% CI, 0.51-1.00; *p* 0.05)

- Intensive care unit stay
- Total hospital stay
- Ventilation time
- Operative times were longer

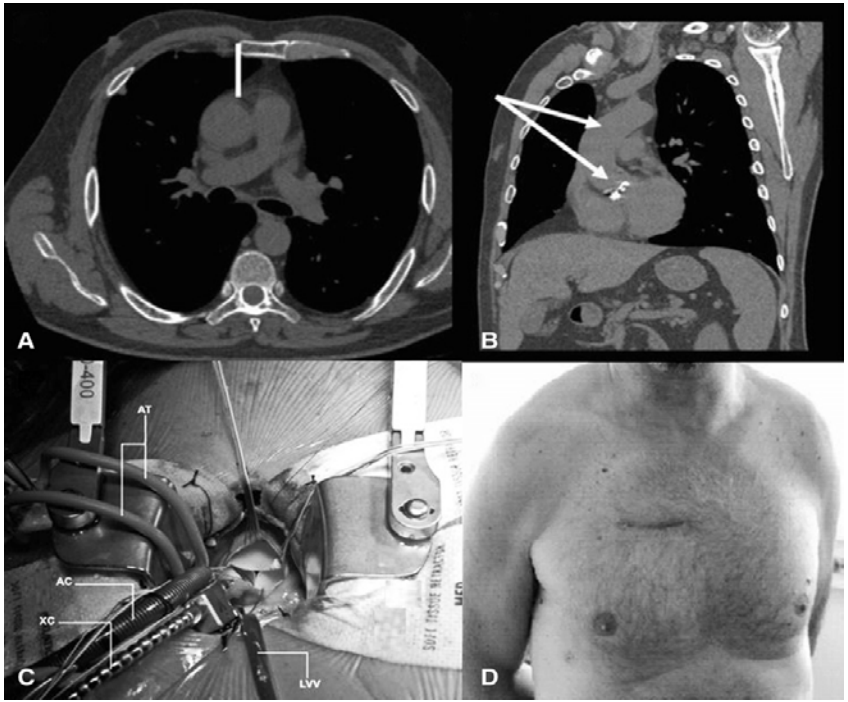
CONCLUSIONS
Suggests that MIAVR (MS) is a safe alternative to CAVR

Minimally invasive aortic valve replacement via right anterior minithoracotomy: Early outcomes and midterm follow-up

Mattia Glauber, MD, Antonio Miceli, MD, Stefano Bevilacqua, MD, and Pier A. Farneti, MD, Massa, Italy

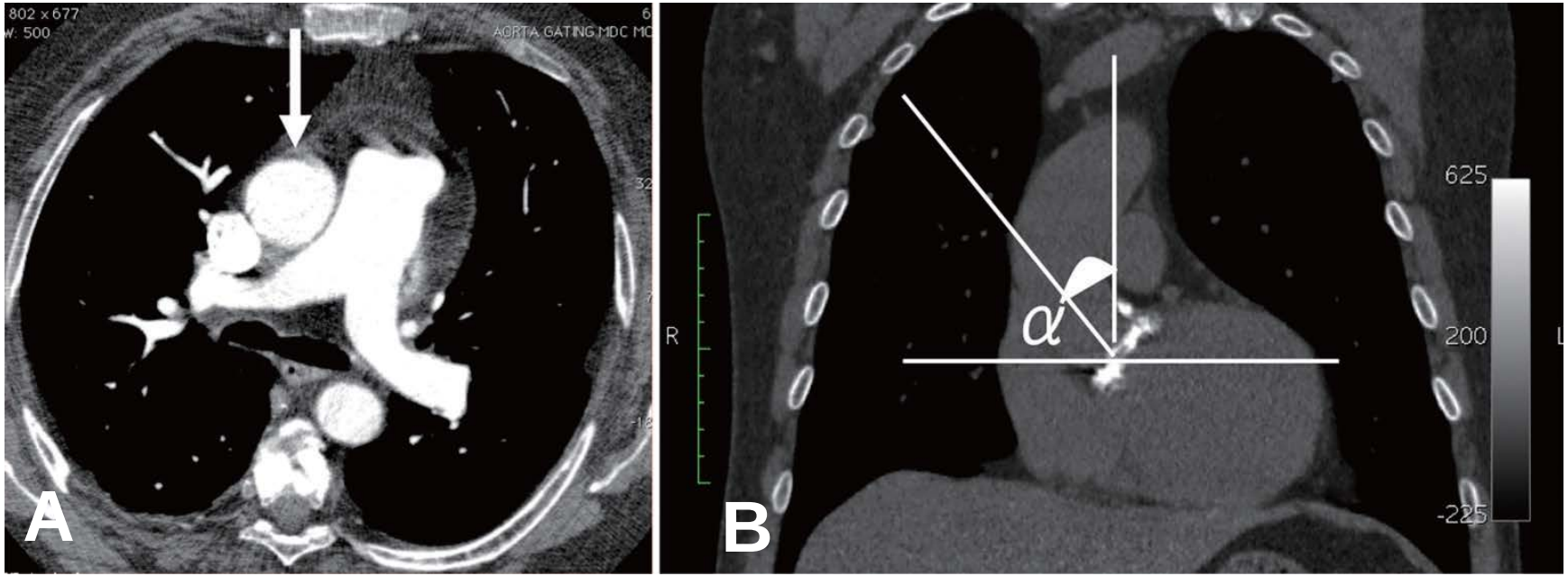
Journal of Thoracic and Cardiovascular Surgery 2011; 142: 1577 -9

- **2011 Reported first experience with MIAVR using the RT**
- *Excellent surgical results in terms of:*
  - ***Mortality***
  - ***Morbidities***
  - ***Patient satisfaction***



Glauber et al. Minimally invasive aortic valve: present and future. *Ann Cardiothorac Surg* 2015;4(1):26-32

Rigth Thoracotomy criteria.

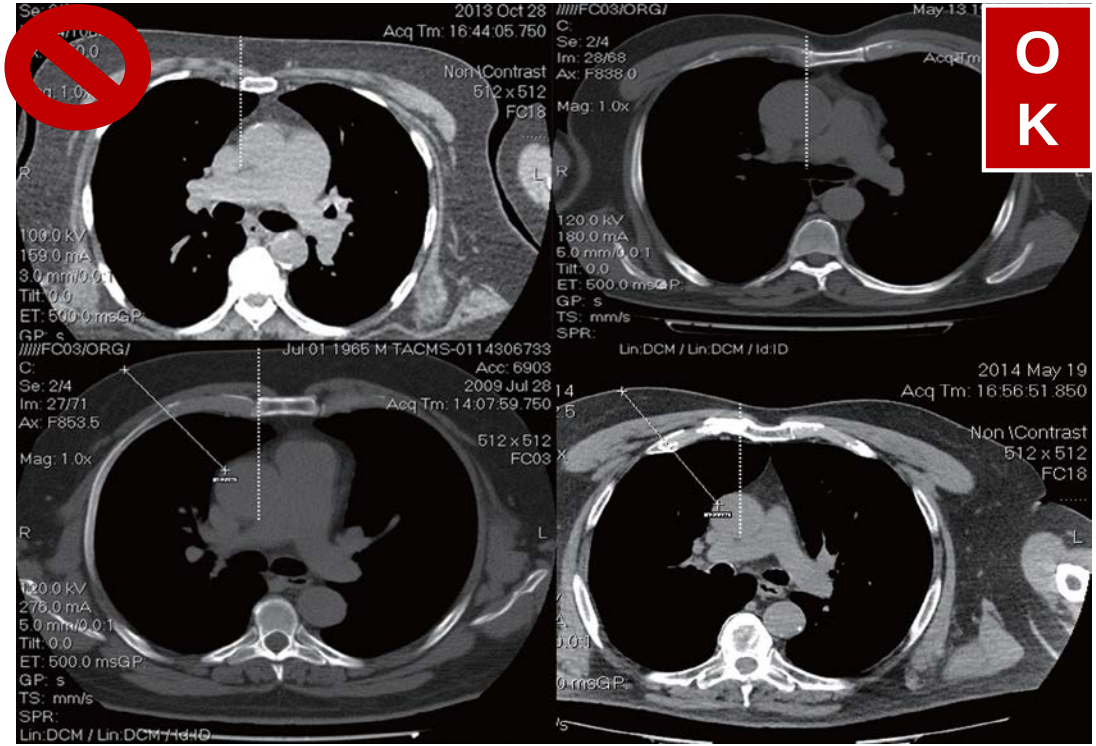


Glauber et al. Minimally invasive aortic valve: present and future.
***Ann Cardiothorac Surg* 2015;4(1):26-32**

Gilmanov et al. Minimally invasive aortic valve replacement: 12-year single center experience.

Ann Cardiothorac Surg 2015;4(2):160-169

CT was used for planing in 98% of the patients for RT vs MS



Minimally invasive aortic valve replacement: 12-year single center experience

Daniyar Gilmanov, Marco Solinas, Pier Andrea Farneti, Alfredo Giuseppe Cerillo, Enkel Kallushi, Filippo Santarelli, Mattia Glauber

Ann Cardiothorac Surg 2015;4(2):160-169

- **MIAVR: MT y MS**
- **853 pts.**
- **2002-2014**

592 –(MT)
261 –(MS)

- **405 (47.5%) Mujeres**
- **Edad Media 73.8 años**

Median follow-up of 29.1 months (2,676.0 patient-years)
Survival rates:
1 years were 96%±1%
5 years and 80%±3%

Overall patients outcomes	
Variable	**n= 853**
30-day mortality	16 (1.9%)
CPB time (median)	108
Aortic Cross-clamp time (median)	75
Conversion to Full median sternotomy	19 (2.2%)
Re-exploration for bleeding	37 (4.3%)
Perioperative stroke	15 (1.8%)
Transient ischemic attack	11 (1.3%)
New onset atrial fibrillation	243 (28.5%)

Minimal access versus conventional aortic valve replacement: a meta-analysis of propensity-matched studies†

Sharaf-Eldin Shehada[a,*,‡], Yacine Elhmidi[b,‡], Fanar Mourad[a], Daniel Wendt[a], Mohamed El Gabry[a], Jaroslav Benedik[a], Matthias Thielmann[a] and Heinz Jakob[a]

Interactive CardioVascular and Thoracic Surgery (2017) 1–9

CAVR (Full sternotomy)
MAAVR (partial sternotomy and a right minithoracotomy)

- ***Reduce the invasiveness**
- ***Same quality, safety and results of the conventional approach.**

A total of 4558 patients
9 studies were enrolled;
2279 (50%) underwent CAVR
2279 (50%) underwent MAAVR

Early and late outcomes and complications were compared in the selected studies.

Table 1: Summary of the total incidences of the end-points of the meta-analysis

	MAAVR	CAVR	*P*-value
Primary end-points			
Early mortality, *n* (%)	34/2279 (1.5)	51/2279 (2.2)	0.14
Stroke, *n* (%)	33/2279 (1.4)	45/2279 (2.0)	0.20
Renal insufficiency, *n* (%)	96/2141 (4.5)	129/2141 (6.0)	0.71
Myocardial infarction, *n* (%)	7/1653 (0.4)	9/1653 (0.5)	0.65
Low cardiac output, *n* (%)	24/1721 (1.4)	40/1721 (2.3)	0.05
Respiratory insufficiency, *n* (%)	139/1550 (9.0)	156/1550 (10.1)	0.45
Secondary end-points			
Re-exploration for bleeding, *n* (%)	112/2279 (4.9)	93/2279 (4.1)	0.27
Wound infection	3/1108 (0.3)	11/1108 (0.9)	0.1
Cross-clamp time (range), mean ± SD	59 ± 14–106 ± 45	54 ± 17–101 ± 39	<0.0001
CPB time (range), mean ± SD	79 ± 20–151 ± 43	80 ± 24–130 ± 66	0.0008
Atrial fibrillation, *n* (%)	136/1165 (11.7)	185/1165 (15.9)	0.01
Permanent pacemaker, *n* (%)	43/1300 (3.3)	53/1300 (4.1)	0.31

S.-E. Shehada et al. Minimal access versus conventional aortic valve replacement: a meta-analysis of propensity-matched studies

Interactive CardioVascular and Thoracic Surgery (2017) 1–9

MAAVR
Significantly lower rate
- **Postoperative low output syndrome**
- **AF**

RESULTS

MAAVR →Significantly longer
Aortic cross-clamp and CPB times
it was not associated with greater cardiopulmonary bypass-related adverse effects

MAAVR vs CAVR

- Incidence of early deaths
- Stroke
- Myocardial infarction
- Renal injury
- Respiratory complications
- Reexploration for bleeding
- Pacemaker implantation

Similar in both groups

MAAVR could be considered the routine procedure for patients with primary isolated aortic valve diseases.

Glauber et al. Minimally invasive aortic valve: present and future.

***Ann Cardiothorac Surg* 2015;4(1):26-32**

Criticisms MIAVR

1. Appears to be more related to improved cosmetic results rather than better clinical outcomes

   <u>TODAY…. MIAVR has been shown to have equivalent results to the standard FS approach</u>

   REDUCED SURGICAL INVASIVENESS WHICH PATIENTS PREFER

2. **Morbidity associated with peripheral cannulation**, which may cause wound infection, pseudoaneurysms and neurological events

Inconsistent data available

Optimal cannulation strategy should be individualized to the specific patient

Glauber et al. Minimally invasive aortic valve: present and future.

***Ann Cardiothorac Surg* 2015;4(1):26-32**

Criticisms MIAVR

3. Regards the costs related to the minimally invasive surgical instrumentations ----***More expensive---- but,***

- ✓**Less rate of postoperative complications**
- ✓**Shorter hospital stay**
- ✓**Faster recovery**

= less resources in the healthy system and therefore lower costs

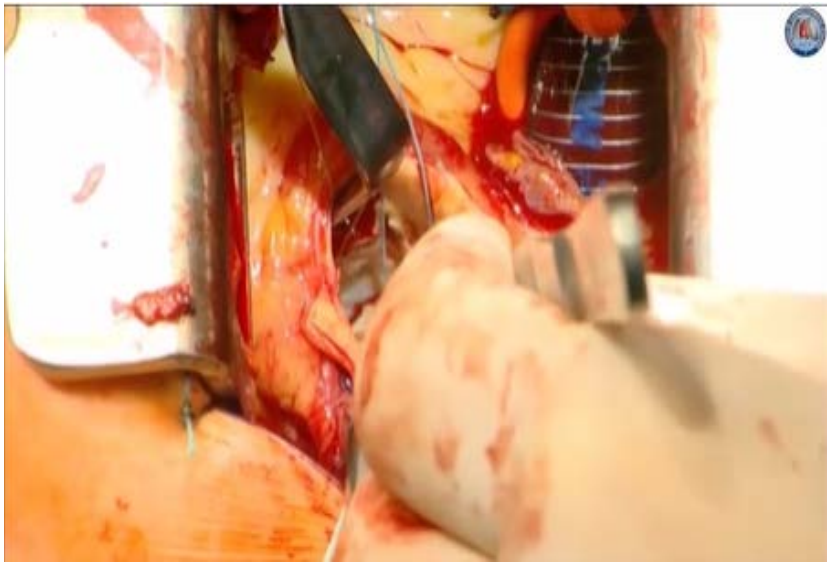
Glauber et al. Minimally invasive aortic valve: present and future.
Ann Cardiothorac Surg 2015;4(1):26-32

Criticisms MIAVR

4. MIS is not “surgeon friendly’ as it is more complex and technically challenging

Diferent learning curve

- ***Deeper operative field***
- ***Limited working space for the exposure and implantation of the prosthetic valve***
- ***Use of new equipmentand methods***



5. MIAVR is associated with longer CPB and cross-clamp time

BEST EVIDENCE TOPIC

Is ministernotomy superior to right anterior minithoracotomy in minimally invasive aortic valve replacement?

Damian Balmforth*, Amer Harky, Kulvinder Lall and Rakesh Uppal

Department of Cardiothoracic Surgery, Barts Heart Centre, St Bartholomew's Hospital, West Smithfield, London, UK

Interactive CardioVascular and Thoracic Surgery (2017) 1–4

THREE-PART QUESTION
In [patients undergoing minimally invasive aortic valve replacement] is [minithoracotomy or ministernotomy] superior in terms of [postoperative outcome]?

** A total of 840 publications were found using the reported search
** 6 represented the best available evidence to answer the clinical question

D. Balmforth et al. / Interactive CardioVascular and Thoracic Surgery (2017) 1-4

Table 1: Best evidence papers

Author, date, journal and country Study type (level of evidence)	Patient group	Outcomes	Key results (RT vs MS)	Comments
Miceli *et al.* (2014), J Thorac Cardiovasc Surg, Italy [2]	406 patients	In-hospital mortality	1.2% vs 1.3% ($P = 1$)	RT associated with less postoperative morbidity but no difference in mortality
	RT group: 251	Postoperative AF	19.5% vs 34.2% ($P = 0.01$)	
Retrospective observational study (level III evidence)	MS group: 155	Ventilation time, median (range)	7 h (5–9) vs 8 h (6–12) ($P = 0.003$)	
		Intensive care stay, median (range)	1 (1–1) vs 1 (1–2) ($P = 0.001$)	
		Ward stay, median (range)	5 (5–6) vs 6 (5–8) ($P = 0.001$)	

Minimally invasive aortic valve replacement using right minithoracotomy is associated with better outcomes than ministernotomy

Antonio Miceli, MD, PhD, Michele Murzi, MD, Danyiar Gilmanov, MD, Raffaele Fugà, MD, Matteo Ferrarini, MD, Marco Solinas, MD, and Mattia Glauber, MD

J Thorac Cardiovasc Surg 2014;148:133-7

Objective: To compare the outcomes of right minithoracotomy (RT) versus ministernotomy (MS) in patients undergoing minimally invasive aortic valve replacement (AVR).

Methods:

- From January 2005 to December 2011

TABLE 3. Outcomes

Variable	RT (n = 251)	MS (n = 155)	*P* value
Mortality	3 (1.2)	2 (1.3)	1
Stroke	3 (1.2)	2 (1.3)	1
Re-exploration for bleeding	12 (4.8)	5 (3.2)	.61
Blood transfusion	51 (20.3)	40 (25.8)	.24
New-onset postoperative AF	49 (19.5)	53 (34.2)	.01
Ventilation time (h)	7 (5-9)	8 (6-12)	.003
ICU stay (d)	1 (1-1)	1 (1-2)	.001
Ward stay (d)	5 (5-6)	6 (5-8)	.0001

Data presented as n (%) or median (range). *RT*, Right minithoracotomy; *MS*, ministernotomy; *AF*, atrial fibrillation; *ICU*, intensive care unit.

Miceli et al.
J Thorac Cardiovasc Surg 2014;148:133-7

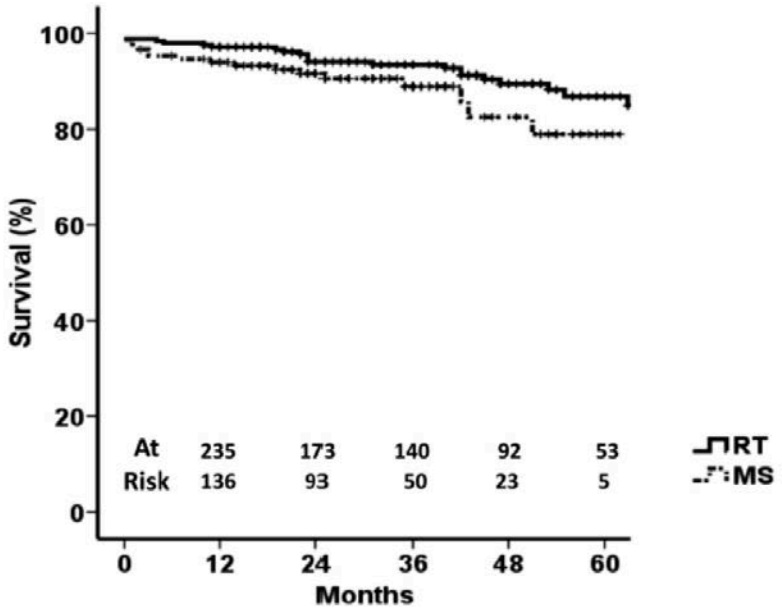


FIGURE 2. Kaplan-Meier curve comparing survival between patients undergoing right thoracotomy *(RT)* versus ministernotomy *(MS)* (log-rank test, $P = .1$).

No difference was found in terms of:
- **cardiopulmonary time,**
- **crossclamping time,**
- **postoperative stroke,**
- **re-exploration for bleeding,**
- **blood transfusion.**

CONCLUSIONS

Minimally invasive AVR is a safe approach associated with low operative mortality and morbidity. However, patients undergoing the RT approach had better outcomes in terms of postoperative AF, ventilation time, and post-operative hospital stay. Prospective randomized trials are required to confirm our data.

D. Balmforth et al. / Interactive CardioVascular and Thoracic Surgery (2017) 1-4

Table 1: Best evidence papers

Author, date, journal and country Study type (level of evidence)	Patient group	Outcomes	Key results (RT vs MS)	Comments
Phan *et al.* (2015), Ann Cardiothorac Surg, Australia [3] Systematic review (level 1 evidence)	Network meta-analysis of 6516 patients	30-day mortality	OR 0.63, 95% CI 0.18–2.17	On direct meta-analysis, RT but not MS was associated with increased CPB and cross-clamp times when compared with CS
		Direct comparison between RT and CS		
		CPB time	WMD 9.99; 95% CI 3.91–16.07 ($P = 0.001$)	
		Cross-clamp time	WMD 7.64, 95% CI 2.86–12.42 ($P = 0.002$)	
		Direct comparison between MS and CS		
		CPB time	WMD 0.47, 95% CI -7.02 to 7.97 ($P = 0.80$)	
		Cross-clamp time	WMD 2.09, 95% CI -2.43 to 6.61 ($P = 0.37$)	

3,258 →MIAVR group
3,258 →CAVR group.

Systematic Review

Ministernotomy or minithoracotomy for minimally invasive aortic valve replacement: a Bayesian network meta-analysis

Kevin Phan[1,2], Ashleigh Xie[1], Yi-Chin Tsai[3], Deborah Black[4], Marco Di Eusanio[1,5], Tristan D. Yan[1,6]

Ann Cardiothorac Surg 2015;4(1):3-14

Table 2 Network meta-analysis of direct and indirect evidence comparisons of MIAVR and CAVR for aortic valve replacement

Outcome	Pooled OR (95% CI) or WMD (95% CI)		
	CS *vs.* MS	CS *vs.* MT	MS *vs.* MT
CPB	−0.30 (−8.64, 7.50)	−9.84 (−22.42, 2.01)	−9.59 (−24.03, 5.47)
Cross-clamp	−2.25 (−8.40, 3.52)	−7.88 (−15.60, 0.05)	−5.62 (−15.16, 4.40)
30-day mortality	1.81 (0.85, 4.07)	1.16 (0.43, 3.08)	0.63 (0.18, 2.17)
Strokes	1.51 (0.69, 3.59)	0.88 (0.34, 2.97)	0.59 (0.17, 2.34)
Reoperation for bleeding	1.01 (0.65, 1.77)	1.01 (0.52, 2.01)	1.00 (0.41, 2.24)
Wound infection	1.18 (0.49, 3.45)	2.09 (0.73, 8.37)	1.67 (0.39, 9.20)

MIAVR, minimally invasive aortic valve replacement; CAVR, conventional aortic valve replacement; OR, odds ratio; WMD, weighted mean difference; CI, confidence interval; CPB, cardiopulmonary bypass; CS, conventional sternotomy; MS, ministernotomy; MT, minithoracotomy.

Phan et al. Network meta-analysis of ministernotomy vs. Minithoracotomy.
***Ann Cardiothorac Surg* 2015;4(1):3-14**

MT was associated with significantly longer CPB and cross-clamp durations.

Reasons:
**MT may provide a limited vision of the aortic valve due to greater distance from the thoracic access*

**This may reduce maneuverability and increase thedifficulty of using long-shaft instruments*

***The increased complexity of the MT procedure** compared to MS and CS approaches could also explain the longer bypass and crossclamp durations observed*

Evidence indicates that MT operations may be longer:

Absolute difference:
****approximately 10 min CPB**
****approximately 5 min cross-clamp**

which may not be clinically significant

Phan et al. Network meta-analysis of ministernotomy vs. Minithoracotomy.
***Ann Cardiothorac Surg* 2015;4(1):3-14**

MT approach requires retrograde arterial perfusion through the femoral artery, which has been associated with increased risk of stroke

Inconsistent data available on femoral versus central cannulation

Optimal cannulation strategy should be individualized to the specific patient

MS which involves a small sternal incision

MT avoids incision of the sternum and rib bones, and thus would reduce wound complication rates and chance of infection

Phan et al. Network meta-analysis of ministernotomy vs. Minithoracotomy.
***Ann Cardiothorac Surg* 2015;4(1):3-14**

Considerations:

- **Complex learning curve**
- **Evidence of equivalent safety in MS and MT**

Best approach: INDIVIDUALIZED
***** Patient***
***** Technical skill***
*****Experience of the heart team involved***

D. Balmforth et al. / Interactive CardioVascular and Thoracic Surgery (2017) 1-4

Table 1: Best evidence papers

Author, date, journal and country Study type (level of evidence)	Patient group	Outcomes	Key results (RT vs MS)	Comments
Hassan *et al.* (2015), J Heart Valve Dis, USA [4]	Non-direct comparison	Additional cost per case of RT over CS (based on 200 cases per year)	US$4194	
Meta-analysis of non-randomized trials (level 1 evidence)	1340 patients	Additional cost per case of MS over CS (based on 200 cases per year)	US$290	
Semsroth *et al.* (2015), Ann Thorac Surg, Austria [5]	160 propensity-matched pairs of RT and MS	90-day mortality	3.8% vs 1.3% ($P = 0.16$)	RT was associated with vascular access complications due to the use of peripheral cannulation
Retrospective observational study (level III evidence)		CPB time	137 min (77–456) vs 113 min (66–339) ($P < 0.001$)	
		Cross-clamp time	93 min (43–231) vs 75 min (42–209) ($P < 0.001$)	
		Conversion to full sternotomy	12.7% vs 4.5% ($P = 0.004$)	
		Second cross-clamp	8.4% vs 1.2% ($P = 0.001$)	

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CONCLUSIONS

- There is a lack of high-quality evidence comparing RT and MS for minimally invasive AVR, with no randomized controlled trials to date.

The available evidence shows no difference in early mortality between RT and MS for surgical AVR.

In studies that directly compared RT and MS:

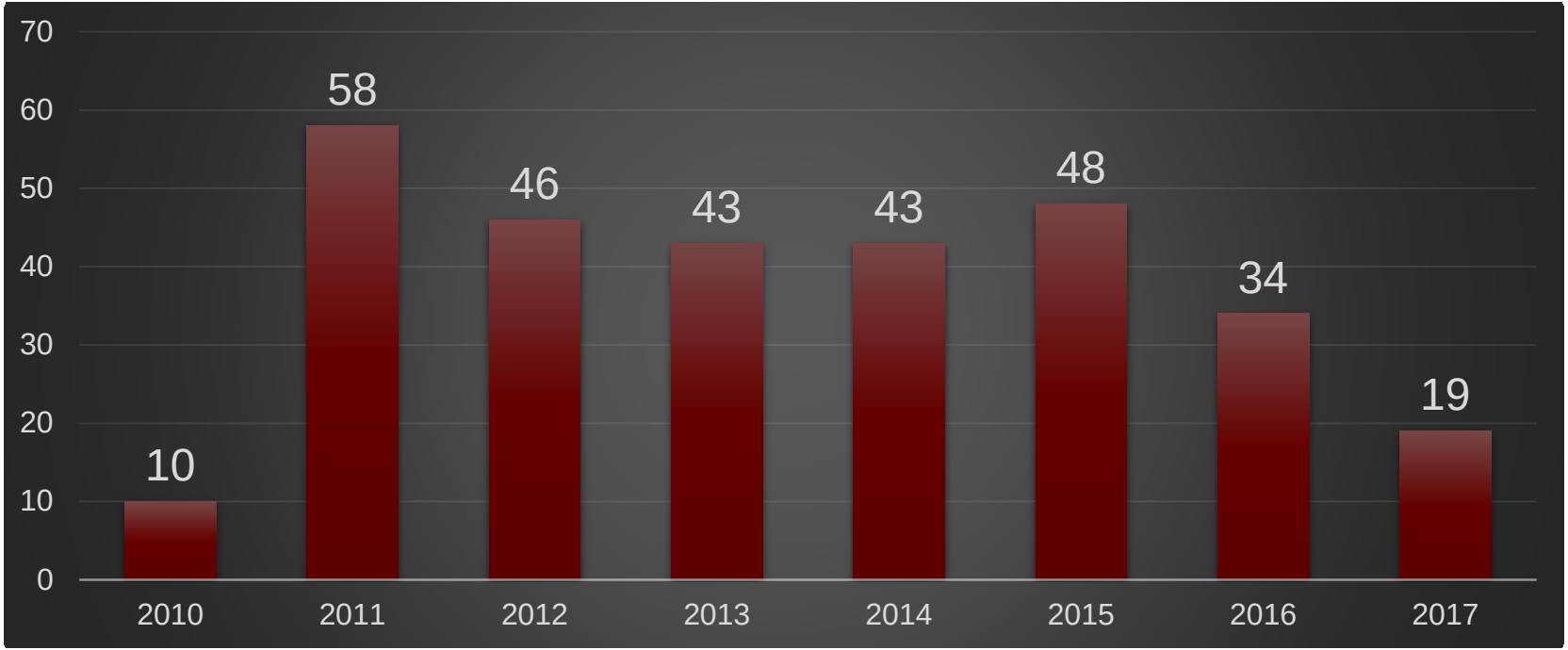
- ***RT was found to be associated with reduced length of hospital stay, despite longer cardiopulmonary bypass times and cross-clamp times.***
- **One study reported groin complications(10.8%) with the RT group**, where peripheral cannulation was used, while the other 5 studies did not comment on groin complications associated with peripheral cannulation.
- **In the only cost–benefit analysis**, RT was found to carry considerably more cost than MS over and above conventional AVR.

Right anterior minithoracotomy for aortic valve replacement: 7-year experience of a single center (Clinica CardioVID – Medellín)

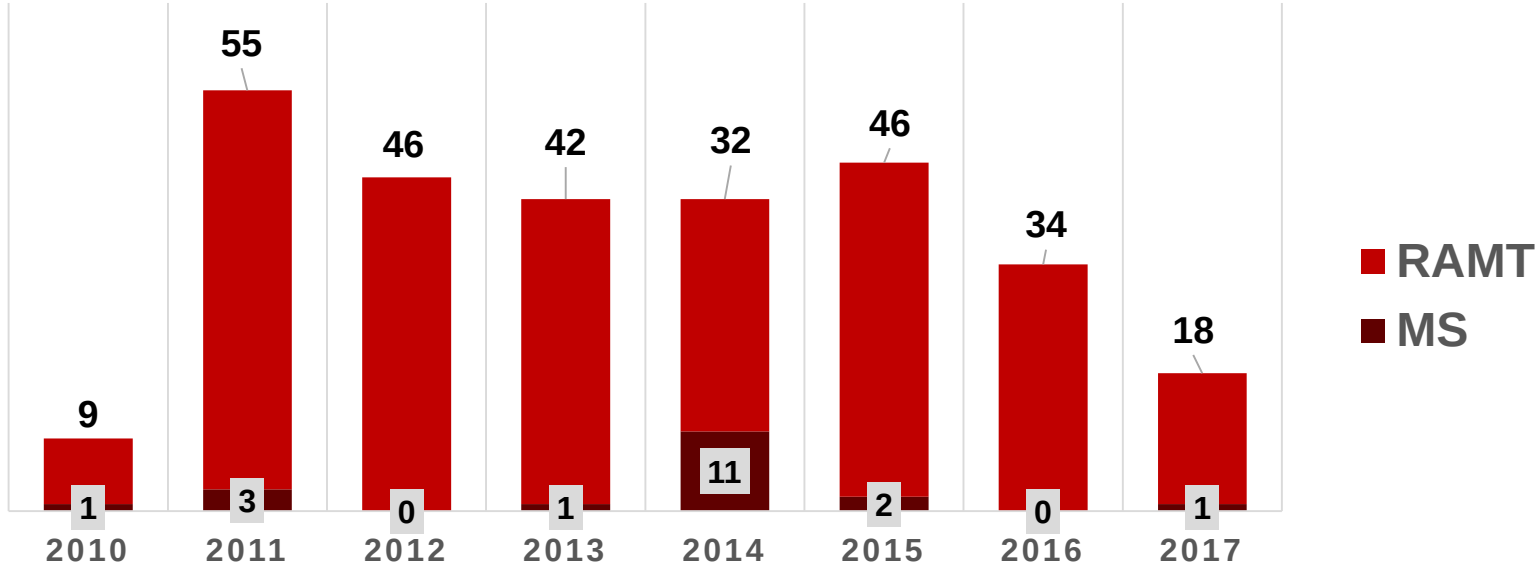
Right anterior minithoracotomy for aortic valve replacement: 7-year experience of a single center

- **Retrospective descriptive observational study of aortic valve replacement**
- **From November 2010 to June 2017**
- **Total of 301 patients Minimally Invasive Aortic Valve Replacement (MIAVR)**
  - **282 Right Anterior Minithoracotomy (RAMT)**
  - **19 Miniesternotomy superior (MS)**

Minimally Invasive Aortic valve replacement (MIAVR): 7-year experience of a single center in Colombia



Aortic Valve Replacement cases perfomed via RAMT over time



RAMT, Right anterior minithoracotomy. MS, Miniesternotomy superior. Year by year (numbers above the bars indicate of the total number of aortic valve replacement operations)

Baseline Preoperative Data

Variable	N = 282
Age (y)	**62 y (18-88 y)**
Female	**107 (37.9%)**
Male	**175 (62.1%)**
Body mass index (kg/m2)	**26.2 ± 4.1 26.0 (15-42)**

Data are presented as mean ± SD, median (interquartile range), or n (%), as appropriate, unless otherwise indicated

Variable	N = 282
Obesity ≥ 30 kg/m2	**47 (16.6%)**
Arterial hypertension	**160 (56.7%)**
Hypercholesterolemia	**107 (37.9%)**
Diabetes mellitus type II	**42 (14.9%)**
Active Smoker	**61 (21.6%)**
Smoking history	**68 (23.4%)**
Hypothyroidism	**34 (12.1%)**
Previous stroke	**2 (0.7%)**
Extracardiac arterial vascular disease	**1 (0.4%)**
Previous cardiac arrhythmia	**3 (1.1%)**
Preoperative atrial fibrillation	**11 (3.9%)**
Previous pacemaker implantation	**4 (1.4%)**
Chronic renal failure/Dialysis	**5 (1.8%)**
Infective endocarditis	**12 (4.2%)**
Chronic obstructive pulmonary disease	**11 (3.9%)**
Previous interventional cardiologic procedure	**10 (3.5%)**
Previous myocardial infarction	**1 (0.4%)**

Baseline Preoperative Data

Variable	N = 282
Left ventricular ejection fraction (%)	**60 (15-75)**
Left ventricular ejection fraction ≤0.5	**63 (22.3%)**
Left ventricular ejection fraction ≤0.3	**18 (6.4%)**

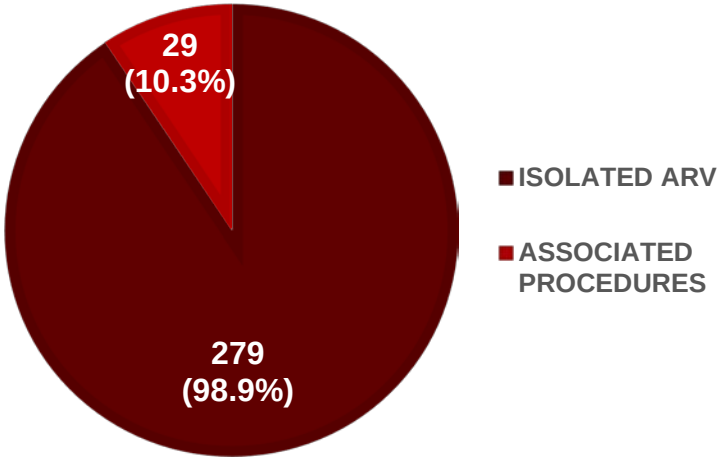
Variable	N = 282
Elective Surgery	**281 (99.6%)**
Out patient	**55 (19.5%)**
In patient	**226 (80.1%)**
Urgent o Emergency	**1 (0.4%)**

Variable	N = 282
Aortic valve pathology	
Stenosis	**173 (61.3%)**
Mixed lesion	**50 (17.7%)**
Regurgitation	**59 (20.9%)**
Bicuspid aortic valve	**110 (39.0%)**
Severe pulmonary hypertension	**10 (3.5%)**

Data are presented as mean ± SD, median (interquartile range), or n (%), as appropriate, unless otherwise indicated

INTRAOPERATIVE DATA.

AORTIC VALVE REPLACEMENT



Variable	(n=282)
Associated procedures	**29 (10.3%)**
* Mitral valve procedure	**16/29 (55.2)**
Repair	**2/16 (12.5)**
Replacement	**14/16 (87.5)**
* Tricuspid valve procedure (Repair)	**2/29 (6.9)**
* Atrial fibrillation ablation	**2/29 (6.9)**
* Others	**13/29 (44.8)**
Aortic subvalvular membrane resection	**1/13**
Venticular septal defect repair	**1/13**
Left atrial appendage closure	**2/13**
Aortic annulus reconstruction (Nick Procedure)	**9/13**

Values are n (%), unless otherwise indicated

INTRAOPERATIVE DATA.

Implanted prosthesis size (mm)	n=282
19	60 (21.3%)
21	70 (24.8%)
23	76 (26.9%)
25	54 (19.1%)
27	19 (6.7%)
29	3 (1.1%)
Median (interquartile range) of implanted prosthesis size (mm)	**23 (19-29)**

Values are n (%), unless otherwise indicated

Prosthesis	n=282
Bioprosthesis	263 (93.3)
Mechanical	19 (6.7)

Cannulation

- ***AV Femoral 282 (100%)**
- ***Internal yugular vein 16 (5.7%)**
- ***** **TEE guidance**

Cardioplegic Solution	N=282
Blood Cardioplegia	32 (11.3)
Plegisol	10 (3.5)
HTK	131 (46.4)
DEL NIDO (Today)	109 (38.6)

OPERATIVE TIMES.

Variable	Overall population MIAVR (n=301)	RAMT (n=282)	MS (n=19)
ACC time (min)			
Mean ± SD	87.1 ± 27.4	87.7 ± 27.6	78.9 ± 22.5
Median (interquartile range)	82 (38-204)	82 (38 -204)	71 (51-139)
CPB time (min)			
Mean ± SD	122.4 ± 41.7	123.5 ± 42.3	107.1 ± 28.8
Median (interquartile range)	115 (61-374)	116 (61-374)	101 (73 -197)

Data are presented as mean ± SD, median (interquartile range)

CPB, cardiopulmonary bypass; ACC, aortic cross clamp.

OVERALL PATIENT OUTCOMES.

Variable	Overall population MIAVR (n=301)	RAMT (n=282)	MS (n=19)
ICU length of stay (d)	2 (0-59)	2 (0-59)	2 (1-7)
Assisted ventilation time (h)			
<24 h	258 (85.7%)	242 (85.8%)	16 (84.2%)
24-48 h	22 (7.3%)	21 (7.45%)	2 (10.5%)
>48 h	21 (6.9%)	19 (6.74%)	1 (5.3%)
Hospital length of stay (d)	7 (2-65)	7 (2-65)	7 (3-13)
Early mortality *	11 (3.65%)	11(3.90%)	0

Values are n (%), or median (range), unless otherwise indicated. ICU, Intensive care unit

***** Early mortality was defined as in-hospital mortality and all deaths within 30 days of operation irrespective of where the death occurred.

OVERALL PATIENT OUTCOMES(1)

Variable	RAMT (n=282)	MS (n=19)
Reopening for bleeding or cardiac tamponade	**23 (8.2%)**	**3 (15.8%)**
Perioperative acute myocardial infarction	2 (0.7)	0
Infective complications 9/282 (3.2%)		
Sepsis	1 (0.4)	0
Superficial infection of thoracotomy	3 (1.1)	0
Deep infection of thoracotomy	3 (1.1)	0
Superficial Infection of the groin	2 (0.7)	0
Stroke *with sequels	2 (0.7)	0
*without sequels	4 (1.4)	0
Convulsions	3 (1.1)	0
Pulmonary complications/respiratory dysfunction	4 (1.4)	0
Pneumonia	4 (1.4)	0
Hemothorax	5 (1.8)	1/19
Pleural effusion requiring puncture	6 (2.1)	1/19

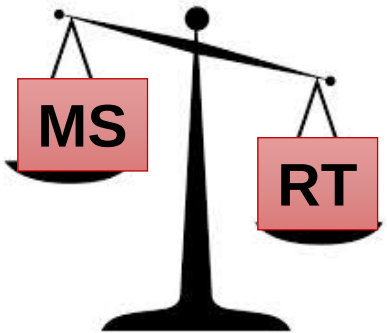
Values are n (%), unless otherwise indicated. ICU, Intensive care unit

OVERALL PATIENT OUTCOMES(2)

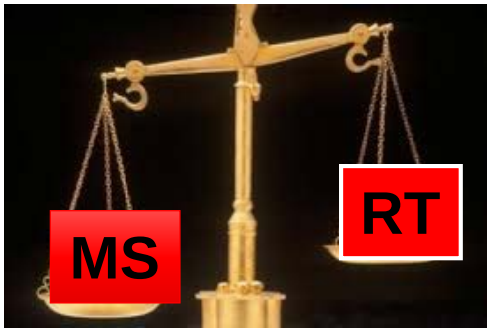
Variable	RAMT (n=282)	MS (n=19)
Perioperative acute kidney injury	1 (0.4%)	0
New-onset CVVH/hemofiltration support	3 (1.1%)	0
Complete AV block; requested PM implant	5 (1.8%)	0
New-onset atrial fibrillation or flutter	36 (12.8%)	0
Gastrointestinal complications 2/282		
Esophageal perforation	1 (0.4%)	0
Hepatic Hematoma	1 (0.4%)	0

Values are n (%), unless otherwise indicated. ICU, Intensive care unit

QUESTION IS NOT WHO IS SUPERIOR?



Best approach: INDIVIDUALIZED
***** Patient***
***** Technical skill***
*****Experience of the heart team involved***



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Thank You

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