1

Current State Surgical Left Atrial Appendage Exclusion

Sebastian Iturra
Cardiac Surgery
Allina Health
March 2024

Minneapolis Heart Institute Foundation | GRAND ROUNDS

2

No conflict of interest

Minneapolis Heart Institute Foundation | GRAND ROUNDS

3

Objectives

- Understanding basis of LAAO for stroke risk reduction
- History of LAA exclusion / Surgical techniques
- LAAO trial / Future trials
- Conclusions

Minneapolis Heart Institute Foundation | GRAND ROUNDS

4

Introduction

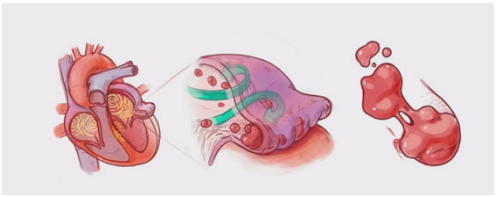
- Atrial fibrillation is an important risk factor stroke
  - 25% of ischemic strokes
  - Disability and death
- Anticoagulation has led to a decrease in stroke
  - Increase risk of bleeding
  - Poor adherence (Warfarin and DOAC)
    - 30% non-adherent w/DOAC

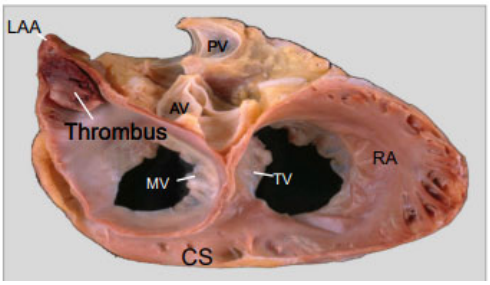
Minneapolis Heart Institute Foundation | GRAND ROUNDS

5

Introduction

- Left atrial thrombi
  - 90% come from LAA
  - 57% in valvular AF



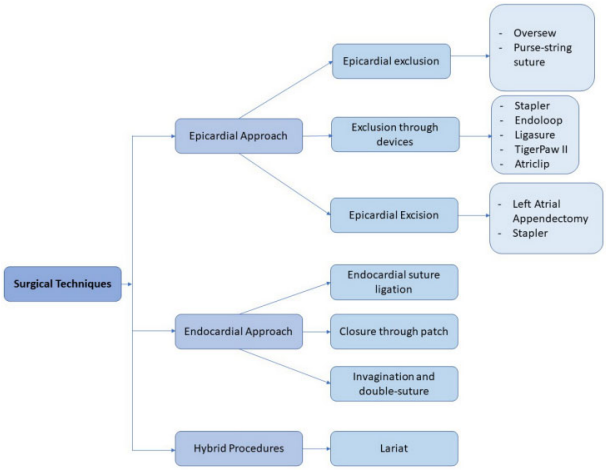


Minneapolis Heart Institute Foundation | GRAND ROUNDS

6

Techniques of Surgical LAAO

- Described since 1948
- Lack of standardization
- Confusing results:
  - Success?
    - Lack of flow
    - Stump < 1 cm.



Minneapolis Heart Institute Foundation | GRAND ROUNDS

7

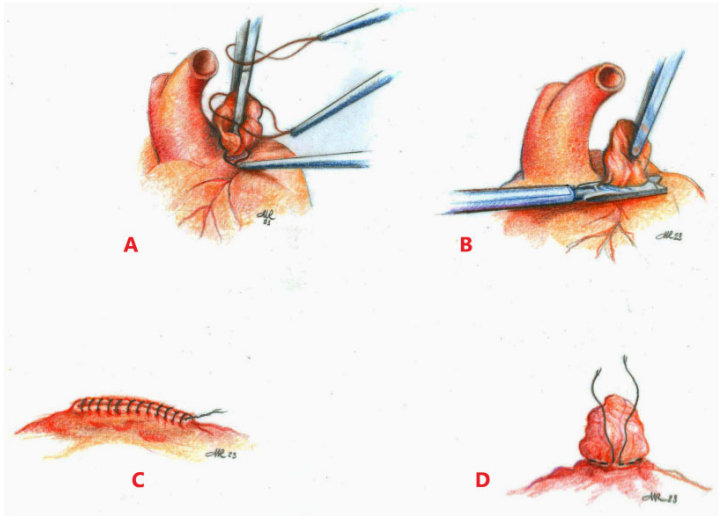
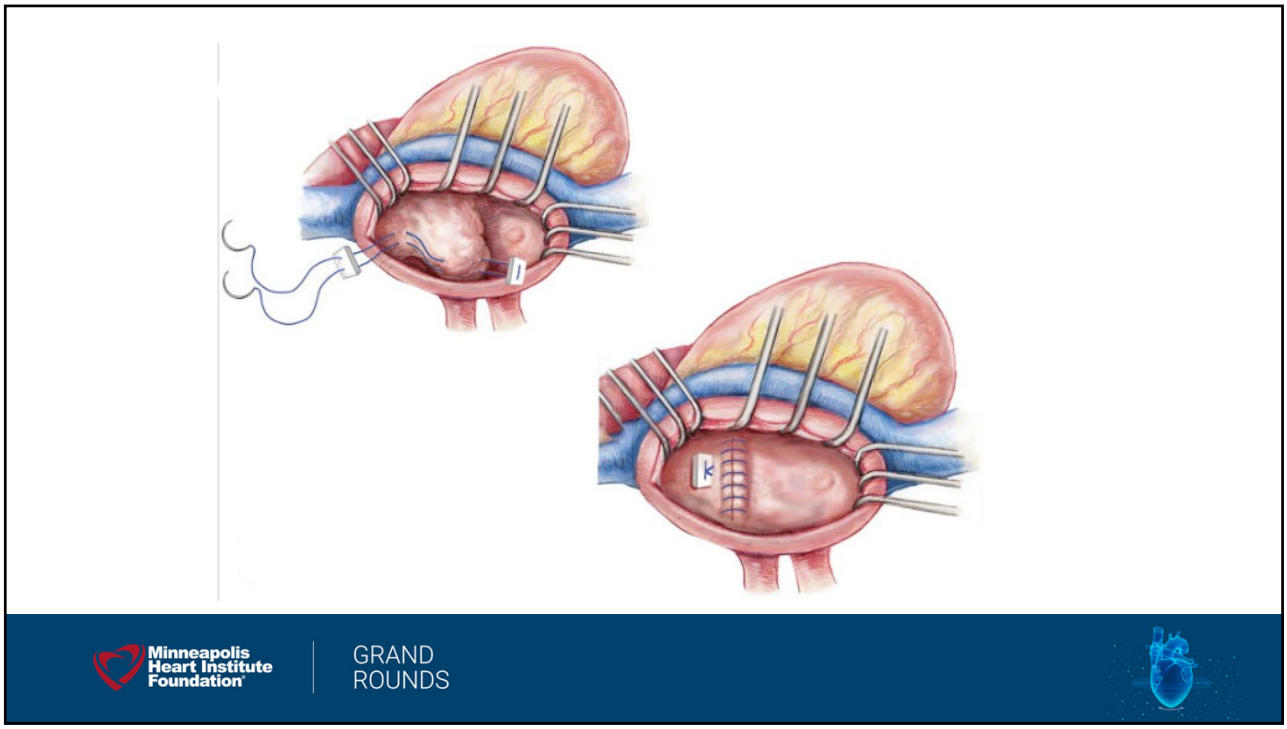


Fig. 3. Surgical techniques of left atrial appendage closure. (A) Endoloop Snaring. (B) Surgical stapler. (C) Epicardial excision. (D) Purse string exclusion.

Minneapolis Heart Institute Foundation | GRAND ROUNDS

Rev. Cardiovasc. Med. 2023; 24(6): 184

8



9

Cardiac Surgery

Success of Surgical Left Atrial Appendage Closure

Assessment by Transesophageal Echocardiography

Anne S. Kanderian, MD,* A. Marc Gillinov, MD,† Gosta B. Pettersson, MD, PHD,† Eugene Blackstone, MD,† Allan L. Klein, MD, FACC*
Cleveland, Ohio

Table 2 Success of Different Techniques of LAA Closure

Type of Closure	n	Patent LAA	Remnant LAA	Excluded LAA With Persistent Flow	Successful LAA Closure
Excision	52	0	14 (27%)	0	38 (73%)*
Suture exclusion, n (%)	73	6 (8)	6 (8)	44 (61)	17 (23)*
Stapler exclusion, n (%)	12	2 (17)	7 (58)	3 (25)	0 (%)†
Total, n (%)	137	8 (6)	27 (20)	47 (34)	55 (40)

*p < 0.001, †p = 0.002.
Abbreviations as in Table 1.

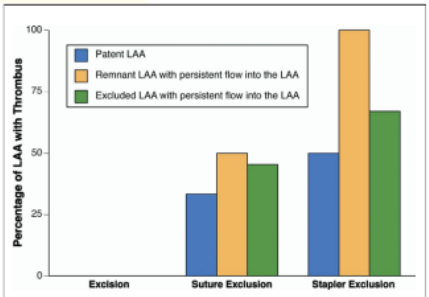


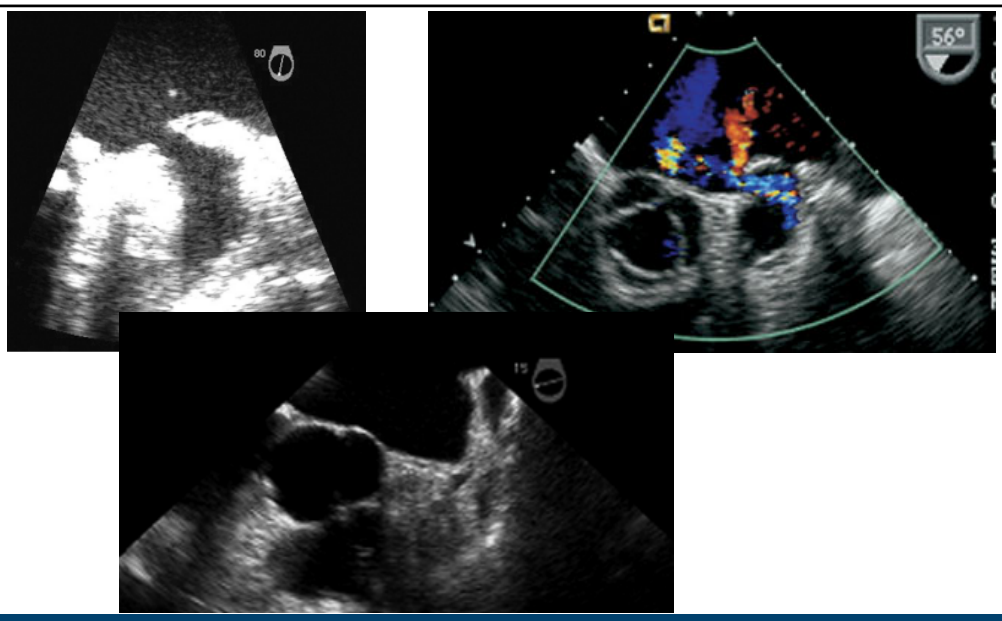
Figure 4 Occurrence of LAA Thrombus in Unsuccessful Surgical Closure

Shown is the presence of left atrial appendage thrombus with unsuccessful surgical left atrial appendage closure by the 3 techniques: excision, suture exclusion, and stapler exclusion. LAA = left atrial appendage.

Minneapolis Heart Institute Foundation
GRAND ROUNDS

J Am Coll Cardiol 2008;52:924–9

10



Minneapolis Heart Institute Foundation | GRAND ROUNDS

J Am Coll Cardiol 2008;52:924–9

11

Outcomes of left atrial appendage occlusion using the AtriClip device: a systematic review

Conor Toale [a], Gerard J. Fitzmaurice [a], Donna Eaton[a], Jonathan Lyne[b] and Karen C. Redmond[a,*]

[a] Department of Thoracic Surgery, The Mater Misericordiae University Hospital, Dublin, Ireland
[b] Department of Cardiology, Blackrock Clinic, Dublin, Ireland

* Corresponding author. Department of Thoracic Surgery, Mater Misericordiae University Hospital, Eccles Street, Dublin, Ireland. Tel: +353-1803-2162; fax: +353-1803-4048; e-mail: karedmond@mater.ie (K.C. Redmond).

Received 14 January 2019; received in revised form 7 May 2019; accepted 19 May 2019

Key question

What are the outcomes of epicardial clipping of the left atrial appendage (LAA) using the AtriClip device?

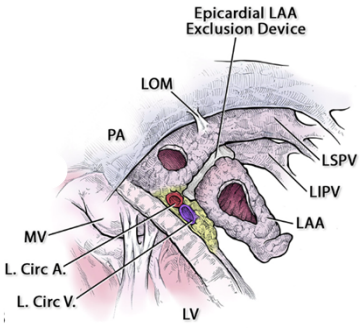
Key finding(s)

LAA occlusion is achieved in 97.8% of patients. No device-related complications have been reported.

Take-home message

The Atriclip™ device is safe and effective in the management of patients with atrial fibrillation.

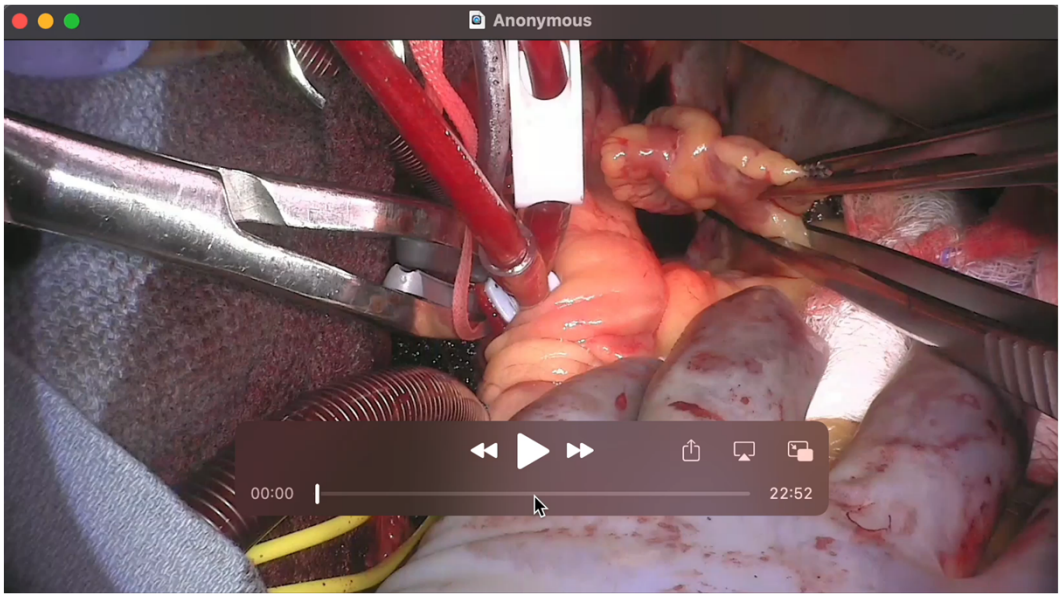
- **93.9-100%** LAA closure success
- No incidences of LAA flow or leak
- No device related complications
- No incidence of bleeding
- No migrations



Minneapolis Heart Institute Foundation | GRAND ROUNDS

Interact Cardiovasc Thorac Surg. 2019 Nov 1;29(5):665-662

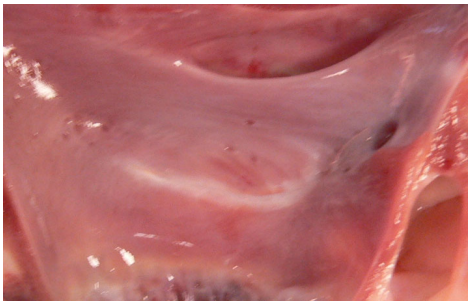
12



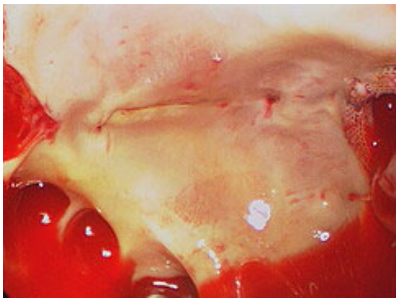
13

Clip Exclusion

- Animal 90 days



Human



14

Left Atrial Appendage Occlusion Study (LAAOS): Results of a randomized controlled pilot study of left atrial appendage occlusion during coronary bypass surgery in patients at risk for stroke

Jeff S. Healey, MD,[a] Eugene Crystal, MD,[b] Andre Lamy, MD,[a] Kevin Teoh, MD,[a] Lloyd Semelhago, MD,[a] Stefan H. Hohnloser, MD,[c] Irene Cybulsky, MD,[a] Labib Abouzahr, MD,[a] Corey Sawchuck, MD,[a] Sandra Carroll, BSc,[a] Carlos Morillo, MD,[a] Peter Kleine, MD,[c] Victor Chu, MD,[a] Eva Lonn, MD,[a] and Stuart J. Connolly, MD[a] *Toronto and Hamilton, Ontario, Canada, and Frankfurt, Germany*

Am Heart J 2005;150:288-93

15

LAAOS

- CABG
  - 77 (n) randomized 2:1 to LAAO:
    - Suture / stapling vs control
  - High risk for AF and stroke
    - Age >75
    - HTN and age >65
    - Previous stroke
    - History AF
  - TEE 8 weeks
    - Failure to occlude if stump >1 cm or flow seen into the LAA
  - Postop anticoagulation was left to discretion of physicians

Am Heart J 2005;150:288-93

16

LAAOS

- Successful closure LAA
  - 72% stapling device
  - 45% epicardial suture alone
- Safe procedure during CABG

Table II. Perioperative events

	Occlusion (n = 52)	Control (n =25)	P
Cross-clamp time (min)	72 ± 27	75 ± 39	.63
Furosemide/72 h (mg)	161 ± 134	156 ± 99	.87
Total chest tube output (mL)	402 ± 230	439 ± 276	.53
Postoperative AF (%)	23	16	.56

Minneapolis Heart Institute Foundation | GRAND ROUNDS

17

ELSEVIER
Canadian Journal of Cardiology
Volume 29, Issue 11, November 2013, Pages 1443-1447

Clinical Research

Left Atrial Appendage Occlusion Study II (LAAOS II)

Richard P. Whitlock MD, PhD [a], Jessica Vincent MSc [a], Mary Helen Blackall BScN [a], Jack Hirsh MD [a], Stephen Fremes MD [b], Richard Novick MD [c], P.J. Devereaux MD, PhD [a], Kevin Teoh MD [a], Andre Lamy MD [a], Stuart J. Connolly MD [a], Salim Yusuf DPhil [a], Michel Carrier MD [d], Jeff S. Healey MD [a]

- Pilot trial of AF and increased risk of stroke
  - Randomized LAAOS 26 vs 25 no occlusion and anticoagulation
  - Procedure was safe
  - At 1 year:
    - 15.4% vs. 20.0%
      - Composite endpoint of death, MI, stroke, noncerebral systemic emboli, or major bleeding (RR, 0.71; 95%, CI, 0.19-2.66; *P* = 0.61)

Minneapolis Heart Institute Foundation | GRAND ROUNDS

18

European Journal of Cardio-Thoracic Surgery 47 (2015) 847–854
doi:10.1093/ejcts/ezu291 Advance Access publication 26 July 2014

ORIGINAL ARTICLE

Cite this article as: Tsai Y-C, Phan K, Munkholm-Larsen S, Tian DH, La Meir M, Yan TD. Surgical left atrial appendage occlusion during cardiac surgery for patients with atrial fibrillation: a meta-analysis. Eur J Cardiothorac Surg 2015;47:847–54.

Surgical left atrial appendage occlusion during cardiac surgery for patients with atrial fibrillation: a meta-analysis

Yi-Chin Tsai[a,†], Kevin Phan[b,c,†], Stine Munkholm-Larsen[c,d], David H. Tian[b], Mark La Meir[e,f] and Tristan D. Yan[b,g,*]

[a] Department of Cardiothoracic Surgery, The Prince Charles Hospital, Chermside, Australia
[b] The Collaborative Research (CORE) Group, Macquarie University, Sydney, Australia
[c] Sydney Medical School, University of Sydney, Sydney, Australia
[d] Department of Cardiology, Hvidovre University Hospital, Copenhagen, Denmark
[e] Department of Cardiothoracic Surgery and Cardiology, Academic Hospital Maastricht and Cardiovascular Research Institute Maastricht, Maastricht, Netherlands
[f] University Hospital Brussels, Brussels, Belgium
[g] Department of Cardiothoracic Surgery, Royal Prince Alfred Hospital, University of Sydney, Sydney, Australia

* Corresponding author. The Collaborative Research (CORE) Group, Macquarie University, 2 Technology Place, Sydney, Australia. E-mail: tristanyan@annalscts.com (T.D. Yan).

Received 26 March 2014; received in revised form 6 June 2014; accepted 12 June 2014

19

Study or Subgroup	LAA surg Events	Total	non-LAA surg Events	Total	Weight	Odds Ratio M-H, Random, 95% CI
30-day						
Healey	1	52	0	25	4.4%	1.49 [0.06, 37.76]
Kim	14	1405	17	662	89.7%	0.38 [0.19, 0.78]
Lee	1	119	1	119	5.9%	1.00 [0.06, 16.18]
Nagpal	0	22	0	21		Not estimable
Subtotal (95% CI)		**1598**		**827**	**100.0%**	**0.43 [0.22, 0.84]**
Total events	16		18			
Heterogeneity: Tau² = 0.00; Chi² = 1.03, df = 2 (P = 0.60); I² = 0%						
Test for overall effect: Z = 2.46 (P = 0.01)						
Latest follow-up						
Garcia-Fernandez	2	58	25	147	23.3%	0.17 [0.04, 0.76]
Healey	2	52	0	25	5.4%	2.52 [0.12, 54.58]
Kim	6	631	9	631	47.0%	0.66 [0.23, 1.88]
Lee	1	119	2	119	8.7%	0.50 [0.04, 5.54]
Nagpal	1	22	1	21	6.3%	0.95 [0.06, 16.28]
Whitlock	1	26	3	25	9.3%	0.29 [0.03, 3.03]
Subtotal (95% CI)		**908**		**968**	**100.0%**	**0.48 [0.24, 0.98]**
Total events	13		40			
Heterogeneity: Tau² = 0.00; Chi² = 3.78, df = 5 (P = 0.58); I² = 0%						
Test for overall effect: Z = 2.01 (P = 0.04)						

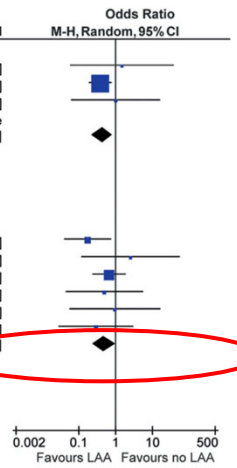
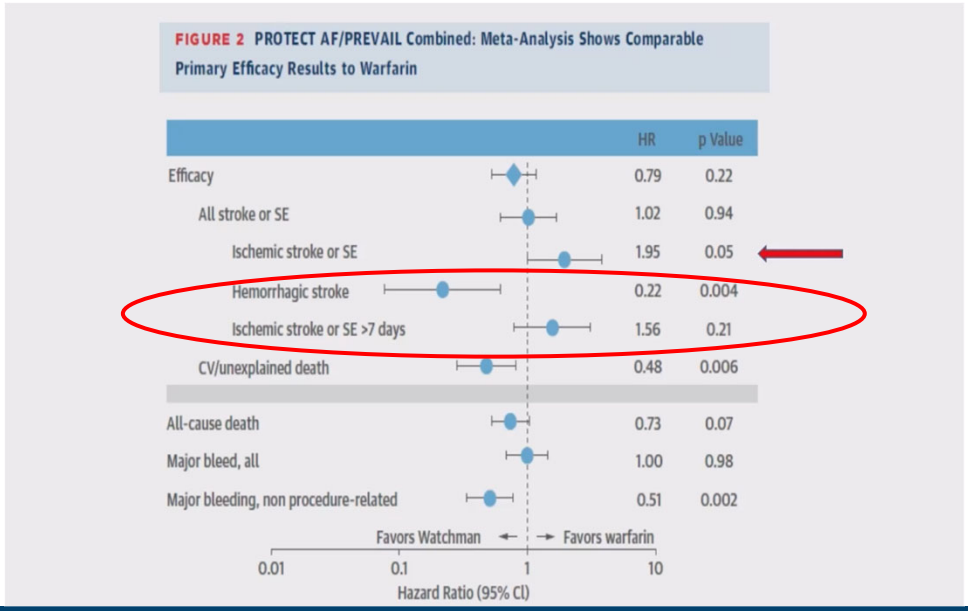


Figure 1: Forest plot of the odds ratio (OR) of embolic stroke incidence postoperatively on Day 30 and at the latest follow-up in the left atrial occlusion (LAA) group versus non-LAA group. The estimate of the OR of each trial corresponds to the middle of the squares, and the horizontal line shows the 95% confidence interval (CI). On each line, the number of events as a fraction of the total number is shown for both treatment groups. For each subgroup, the sum of the statistics, along with the summary OR, is represented by the middle of the solid diamonds. A test of heterogeneity between the trials within a subgroup is given below the summary statistics. M–H: Mantel–Haenszel.

ADULT CARDIAC

20



Minneapolis Heart Institute Foundation | GRAND ROUNDS

J Am Coll Cardiol. 2017;70(24):2964–75

21

The NEW ENGLAND JOURNAL of MEDICINE
ESTABLISHED IN 1812 JUNE 3, 2021 VOL. 384 NO. 22

Left Atrial Appendage Occlusion during Cardiac Surgery to Prevent Stroke

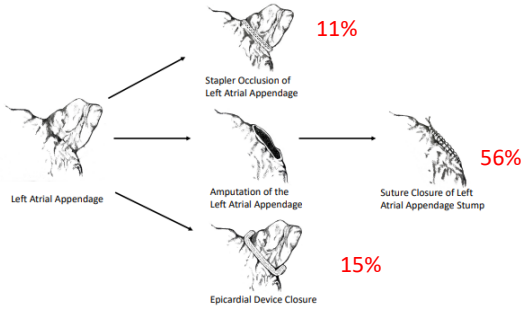
R.P. Whitlock, E.P. Belley-Cote, D. Paparella, J.S. Healey, K. Brady, M. Sharma, W. Reents, P. Budera, A.J. Baddour, P. Fila, P.J. Devereaux, A. Bogachev-Prokophiev, A. Boening, K.H.T. Teoh, G.I. Tagarakis, M.S. Slaughter, A.G. Royse, S. McGuinness, M. Alings, P.P. Punjabi, C.D. Mazer, R.J. Folkeringa, A. Colli, Á. Avezum, J. Nakamya, K. Balasubramanian, J. Vincent, P. Voisine, A. Lamy, S. Yusuf, and S.J. Connolly, for the LAAOS III Investigators*

Minneapolis Heart Institute Foundation | GRAND ROUNDS

N Engl J Med 2021;384:2081-91

22

- Randomized LAAO vs. no LAAO:
  - Cardiac surgery with the use CBP
  - Atrial fibrillation
  - CHA2DS2-VASc ≥2
- Primary outcome:
  - Ischemic stroke or systemic embolism
- Guidelines directed stroke prevention therapy (OAC agents)
  - Left to their local physicians



Minneapolis Heart Institute Foundation | GRAND ROUNDS

N Engl J Med 2021;384:2081-91

23

Benefits of Ablation and Left Atrial Appendage Management in Atrial Fibrillation

Operative Safety Outcomes

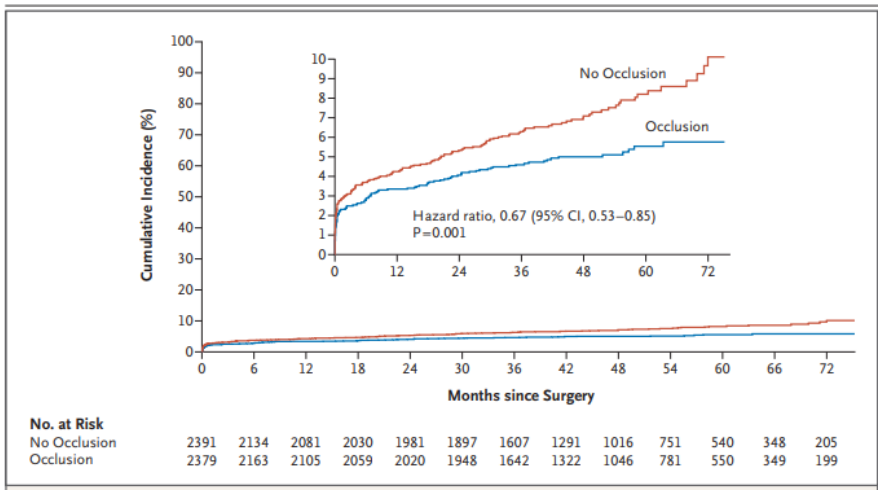
	LAAO n=2379	No LAAO n=2391	p-value*
Bypass time, mean (SD)	119 min (48)	113 min (47)	<0.001
Cross-clamp time, mean (SD)	86 min (37)	82 min (37)	<0.001
Chest tube output, median (IQR)	520 ml (350-790)	500 ml (340-760)	0.06
Re-operation for bleeding	94 (4.0%)	95 (4.0%)	0.97
Prolongation of hospitalization due to heart failure	5 (0.2%)	14 (0.6%)	0.04
30-day mortality	89 (3.7%)	95 (4.0%)	0.68

*Not adjusted for multiplicity

Minneapolis Heart Institute Foundation | GRAND ROUNDS

N Engl J Med 2021;384:2081-91

24

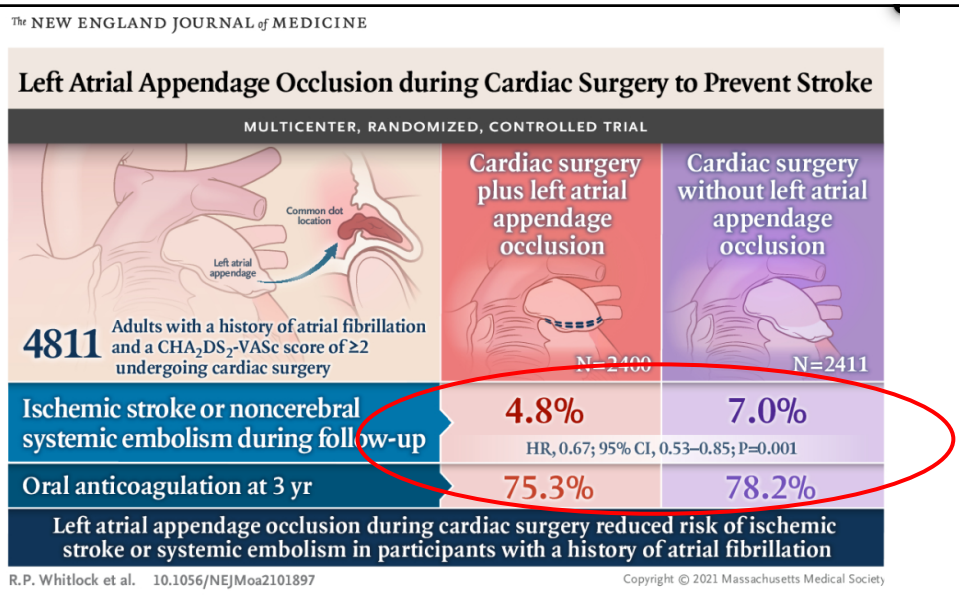


- LAAOS III did not compare LAAO with anticoagulation

Minneapolis Heart Institute Foundation | GRAND ROUNDS

N Engl J Med 2021;384:2081-91

25



Minneapolis Heart Institute Foundation | GRAND ROUNDS

26

Circulation

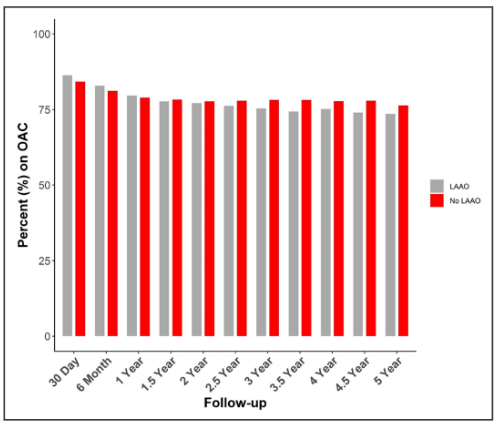
ORIGINAL RESEARCH ARTICLE

Oral Anticoagulation Use and Left Atrial Appendage Occlusion in LAAOS III

Stuart J. Connolly, MD; Jeff S. Healey, MD; Emilie P. Belley-Cote, MD, PhD; Kumar Balasubramanian, MSc; Domenico Paparella, MD; Katheryn Brady, BSc; Wilko Reents, MD; Bernhard C. Danner, MD; P.J. Devereaux, MD, PhD; Mukul Sharma, MD; Chinthanie Ramasundarahettige, MSc; Salim Yusuf, DPhil; Richard P. Whitlock, MD, PhD

Circulation.2023;148:1298–1304. DOI: 10.1161/CIRCULATIONAHA.122.060315

27



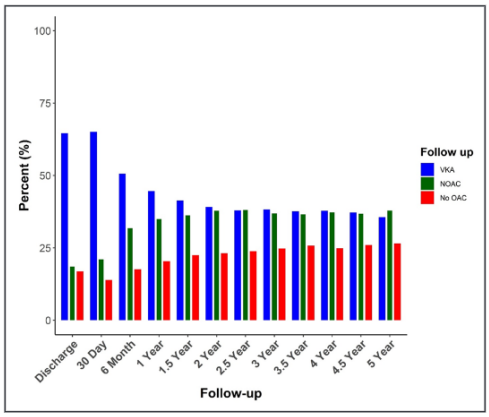


Table 4. Adjusted Cox Proportional Hazard Analyses With Oral Anticoagulant Use as a Time-Dependent Covariate for the Outcome of Ischemic Stroke or Systemic Embolism

	Left atrial appendage occlusion		No left atrial appendage occlusion			
	Events	Incidence/100 person-years	Events	Incidence/100 person-years	Hazard ratio (95% CI)*	Hazard ratio (95% CI)
On oral anticoagulant	56	0.8	85	1.3	0.64 (0.48–0.87)	0.63 (0.45–0.89)
Not on oral anticoagulant	14	0.8	22	1.2		0.63 (0.32–1.23)

*Hazard ratio estimate, adjusted for the use of oral anticoagulants as a time-dependent covariate.

Circulation.2023;148:1298–1304. DOI: 10.1161/CIRCULATIONAHA.122.060315

28

Journal of the American Heart Association
Volume 12, Issue 10, 16 May 2023
https://doi.org/10.1161/JAHA.122.028716

ORIGINAL RESEARCH

Cost Implications of Left Atrial Appendage Occlusion During Cardiac Surgery: A Cost Analysis of the LAAOS III Trial

Adam Eqbal, MD ; Wesley Tong, BSc ; Andre Lamy, MD ; Emilie Belley-Cote, MD, PhD ; Domenico Paparella, MD ; Alexander Bogachev-Prokophiev, MD; Alistair G. Royse, MD ; Wilko Reents, MD ; P. J. Devereaux, MD, PhD ; Katheryn Brady, BSc ; Jessica Vincent, MSc ; Stuart J. Connolly, MD ; Richard P. Whitlock, MD, PhD the LAAOS III Investigators*

- Sub-analysis LAAOS III
- Data Medicare reimbursement
- Increase of cost is driven by stroke
- Overall, cost saving in LAAOS

Minneapolis Heart Institute Foundation | GRAND ROUNDS

29

Guidelines recommendations

Minneapolis Heart Institute Foundation | GRAND ROUNDS

30

Table 2 2019 AHA/ACC/HRS focused update of the 2014 AHA/ACC/HRS guideline for the management of patients with atrial fibrillation.

Recommendations	Class of recommendation	Level of evidence
After surgical occlusion or exclusion of the LAA, it is recommended to continue anticoagulation in at-risk patients with AF for stroke prevention.	I	B
LAA occlusion may be considered for stroke prevention in patients with AF and contraindications for long-term anticoagulant treatment (eg, those with a previous life-threatening bleed without reversible cause).	IIb	B
Surgical occlusion or exclusion of the LAA may be considered for stroke prevention in patients with AF undergoing cardiac surgery.	IIb	B
Surgical occlusion or exclusion of the LAA may be considered for stroke prevention in patients undergoing thoracoscopic AF surgery.	IIb	B

ACC = American College of Cardiology; AF = atrial fibrillation; AHA = American Heart Association; HRS = Heart Rhythm Society; LAA = left atrial appendage.
Adapted from January et al.[19]

Table 3 2020 European Society of Cardiology Guidelines for the management of atrial fibrillation.

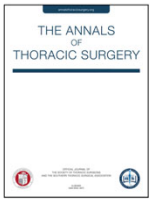
Recommendations for occlusion or exclusion of the LAA	Class of recommendation	Level of evidence
LAA occlusion may be considered for stroke prevention in patients with AF and contraindications for long-term anticoagulant treatment (eg, intracranial bleeding without a reversible cause)	IIb	B
Surgical occlusion or exclusion of the LAA may be considered for stroke prevention in patients with AF undergoing cardiac surgery	IIb	C

AF = atrial fibrillation; LAA = left atrial appendage.
Adapted from Hindricks et al.[20]

Minneapolis Heart Institute Foundation | GRAND ROUNDS

31

Journal Pre-proof



The Society of Thoracic Surgeons 2023 Clinical Practice Guidelines for the Surgical Treatment of Atrial Fibrillation

Moritz C. Wyler von Ballmoos, MD, PhD, Dawn S. Hui, MD, J. Hunter Mehaffey, MD, MSc, S. Chris Malaisrie, MD, Panos N. Vardas, MD, A. Marc Gillinov, MD, Thoralf M. Sundt, MD, Vinay Badhwar, MD

PII: S0003-4975(24)00057-2

DOI: https://doi.org/10.1016/j.athoracsur.2024.01.007

Reference: ATS 37181

To appear in: *The Annals of Thoracic Surgery*

Received Date: 10 November 2023

Revised Date: 8 January 2024

Accepted Date: 13 January 2024

Minneapolis Heart Institute Foundation | GRAND ROUNDS

32

Recommendations for concomitant left atrial appendage management					
It is reasonable to perform left atrial appendage excision or exclusion in conjunction with surgical ablation for AF for longitudinal thromboembolic morbidity prevention.	IIa	C	Left atrial appendage obliteration for atrial fibrillation is recommended for all first-time non-emergent cardiac surgery procedures, with or without concomitant surgical ablation, to reduce morbidity from thromboembolic complications.	I	A
At the time of concomitant cardiac operations in patients with AF, it is reasonable to surgically manage the left atrial appendage for longitudinal thromboembolic morbidity prevention.	IIa	C			

2017 2023

The Society of Thoracic Surgeons

Minneapolis Heart Institute Foundation | GRAND ROUNDS

33

- **Observational data documenting safety & effectiveness**
- Limited comparisons with percutaneous LAAO (procedural risk, bleeding, TE complications)
- SALAMANDER (prospective registry)
- **no RCTs comparing percutaneous vs surgical LAAO vs OMT**

Recommendations regarding stand-alone left atrial appendage management					
			Isolated surgical left atrial appendage obliteration may be considered in patients with longstanding persistent atrial fibrillation, a high stroke risk, and contraindications for or failure of long-term oral anticoagulation.	IIb	B-NR

2017 2023

The Society of Thoracic Surgeons

Minneapolis Heart Institute Foundation | GRAND ROUNDS

34

CLINICAL PRACTICE GUIDELINES

2023 ACC/AHA/ACCP/HRS Guideline for the Diagnosis and Management of Atrial Fibrillation: A Report of the American College of Cardiology/ American Heart Association Joint Committee on Clinical Practice Guidelines

Developed in Collaboration With and Endorsed by the American College of Clinical Pharmacy and the Heart Rhythm Society

Writing Committee Members*

José A. Joglar, MD, FACC, FAHA, FHRS, Chair; Mina K. Chung, MD, FACC, FAHA, FHRS, Vice Chair; Anastasia L. Armbruster, PharmD, FACC†; Emelia J. Benjamin, MD, ScM, FACC, FAHA; Janice Y. Chyou, MD, FACC, FAHA, FHRS; Edmond M. Cronin, MB, BCh, BAO, FHRS; Anita Deswal, MD, MPH, FACC, FAHA†; Lee L. Eckhardt, MD, MS, FHRS; Zachary D. Goldberger, MD, FACC, FAHA, FHRS; Rakesh Gopinathannair, MD, MA, FACC, FAHA, FHRS; Bulent Gorenek, MD, FACC; Paul L. Hess, MD, MHS‡; Mark Hlatky, MD, FACC, FAHA; Gail Hogan§; Chinwe Ibeh, MD; Julia H. Indik, MD, PhD, FACC, FAHA, FHRS; Kazuhiko Kido, PharmD, PhD, MS, FCCP‖; Fred Kusumoto, MD, FACC, FAHA, FHRS; Mark S. Link, MD, FACC, FAHA, FHRS; Kathleen T. Linta § Gregory M. Marcus, MD, MAS, FACC, FAHA, FHRS; Patrick M. McCarthy, MD, FACC; Nimesh Patel, MD; Kristen K. Patton, MD, FACC, FAHA, FHRS; Marco V. Perez, MD, FAHA; Jonathan P. Piccini, MD, MHS, FACC, FAHA, FHRS; Andrea M. Russo, MD, FACC, FAHA, FHRS¶; Prashanthan Sanders, MBBS, PhD, FAHA, FHRS; Megan M. Streur, PhD, MN, ARNP; Kevin L. Thomas, MD, FACC, FHRS; Sabrina Times, DHSC, MPH#; James E. Tisdale, PharmD, FACC, FAHA, FCCP; Anne Marie Valente, MD, FACC, FAHA**; David R. Van Wagoner, PhD, FAHA, FHRS

Circulation. 2024;149:e1–e156. DOI: 10.1161/CIR.0000000000001193

35

AHA/ACC 2023 CPG

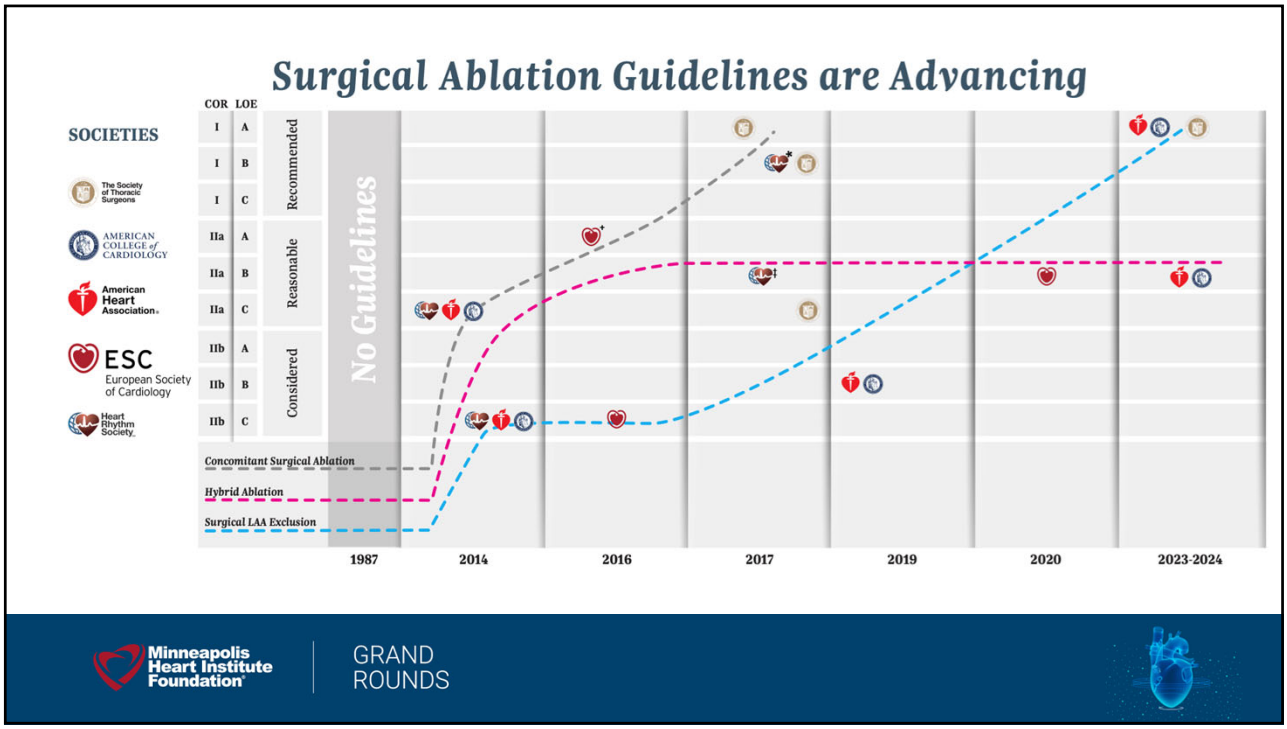
6.5.2. Cardiac Surgery—LAA Exclusion/Excision

Recommendations for Cardiac Surgery—LAA Exclusion/Excision Referenced studies that support the recommendations are summarized in the Online Data Supplement.

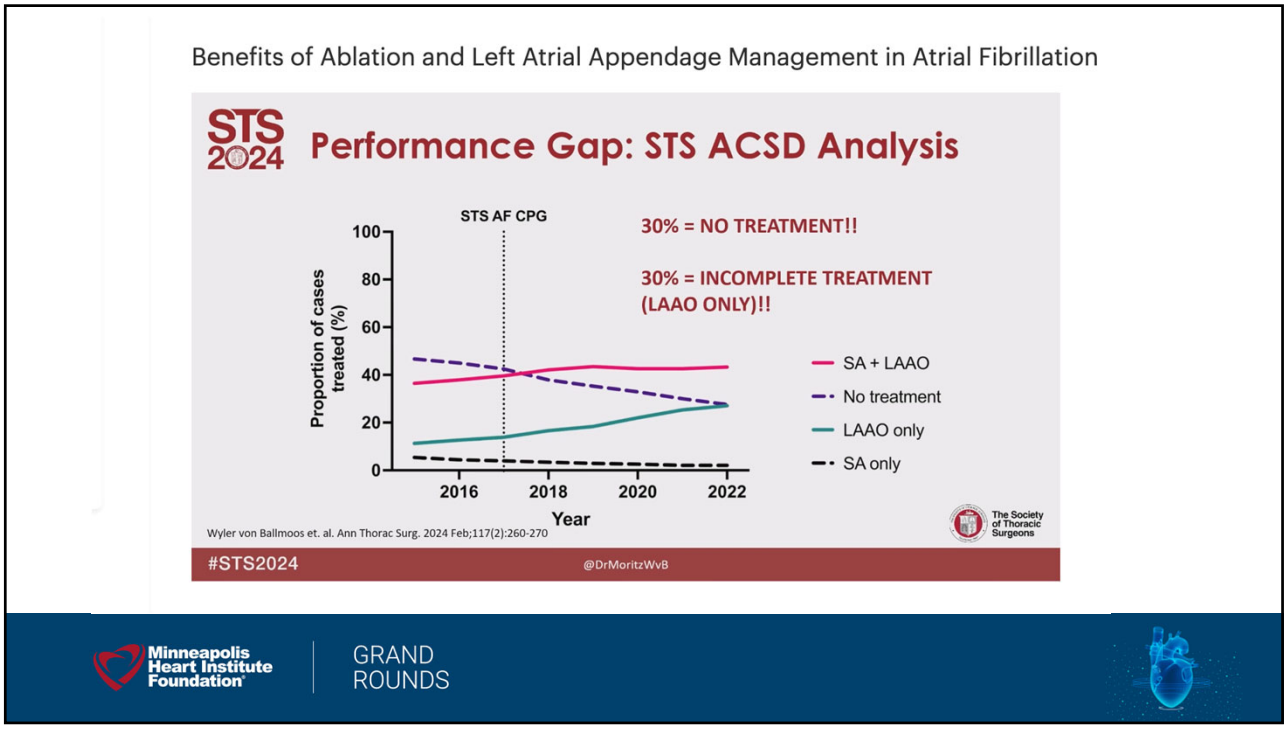
COR	LOE	Recommendations
1	A	1. In patients with AF undergoing cardiac surgery with a CHA_2DS_2-VASc score ≥2 or equivalent stroke risk, surgical LAA exclusion, in addition to continued anti-coagulation, is indicated to reduce the risk of stroke and systemic embolism.[1–3]
1	A	2. In patients with AF undergoing cardiac surgery and LAA exclusion, a surgical technique resulting in absence of flow across the suture line and a stump of <1 cm as determined by intraoperative trans-esophageal echocardiography should be used.[1,4,5]

Circulation. 2024;149:e1–e156. DOI: 10.1161/CIR.0000000000001193

36


Surgical Ablation Guidelines are Advancing
SOCIETIES
The Society of Thoracic Surgeons
AMERICAN COLLEGE of CARDIOLOGY
American Heart Association.
ESC European Society of Cardiology
Heart Rhythm Society
COR LOE
I A
I B
I C
IIa A
IIa B
IIa C
IIb A
IIb B
IIb C
Recommended
Reasonable
Considered
No Guidelines
Concomitant Surgical Ablation
Hybrid Ablation
Surgical LAA Exclusion
1987
2014
2016
2017
2019
2020
2023-2024
Minneapolis Heart Institute Foundation
GRAND ROUNDS

37


Benefits of Ablation and Left Atrial Appendage Management in Atrial Fibrillation
STS 2024
Performance Gap: STS ACSD Analysis
STS AF CPG
30% = NO TREATMENT!!
30% = INCOMPLETE TREATMENT (LAAO ONLY)!!
Proportion of cases treated (%)
100
80
60
40
20
0
2016
2018
2020
2022
Year
SA + LAAO
No treatment
LAAO only
SA only
Wyler von Ballmoos et. al. Ann Thorac Surg. 2024 Feb;117(2):260-270
The Society of Thoracic Surgeons
#STS2024
@DrMoritzWvB
Minneapolis Heart Institute Foundation
GRAND ROUNDS

38

Electrical Isolation Following Thoracoscopic Left Atrial Appendage Exclusion During Hybrid Ablation for Longstanding Persistent Atrial Fibrillation

Syed M. Ali Hassan[1], Sarah Paleczny[1], Bobby Yanagawa[2], Benedict Glover[3], Gianluigi Bisleri[2]

[1]Division of Cardiac Surgery, Queen's University, Kingston, ON, Canada
[2]Division of Cardiac Surgery, University of Toronto, Toronto, ON, Canada
[3]Division of Cardiology, University of Toronto, Toronto, ON, Canada

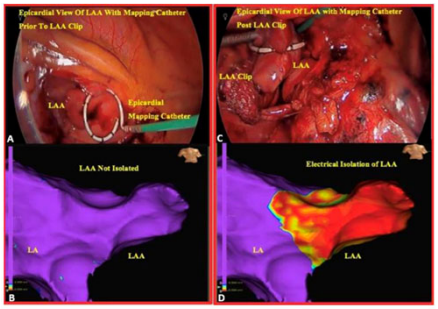


Figure 1: A) Baseline epicardial mapping of the LAA showing B) electrical activity (purple; voltage > 0.5mV). C) Epicardial mapping after AtriClip LAA exclusion D) showing complete electrical isolation (red).

Minneapolis Heart Institute Foundation | GRAND ROUNDS

Interactive CardioVascular and Thoracic Surgery 15(2012) 416-419

39

Hemodynamics of LAA

- LAA has a role:
  - Complementary reservoir
  - Producing atrial and brain natriuretic peptide
- Unknown effect of LAAO on healthy atrium:
  - Increase of diuretics treatment on LAAO?

Minneapolis Heart Institute Foundation | GRAND ROUNDS

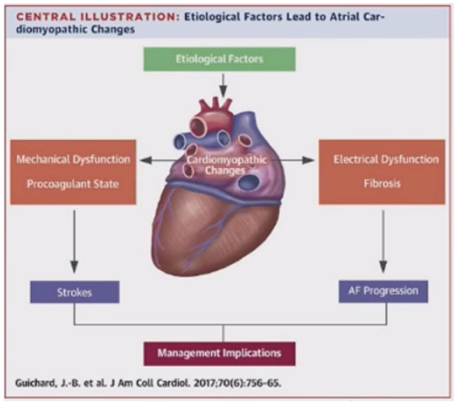
40

Future Trials

41

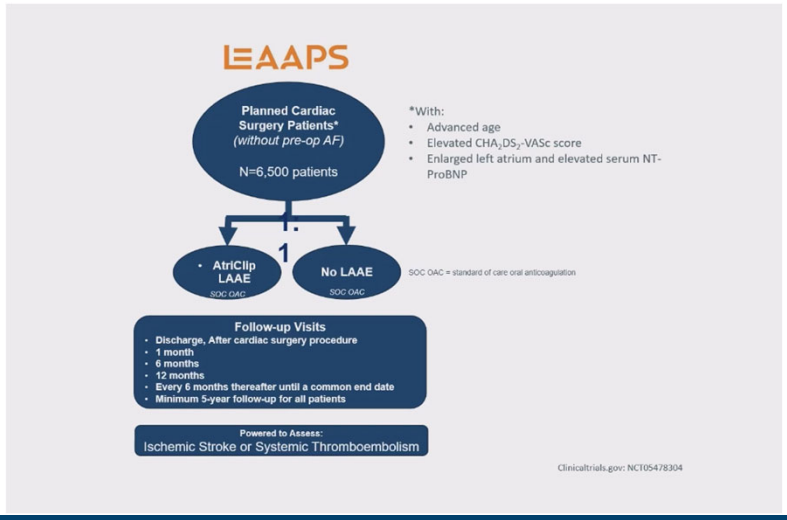
Should every patient cardiac patient be considered for LAAO?

- 50% cardiac patients risk factors for AF / Stroke:
  - Atrial cardiomyopathy
  - HTN / age >75 / HF / valve disease / LA enlargement
  - Only one surgical chance of LAAO



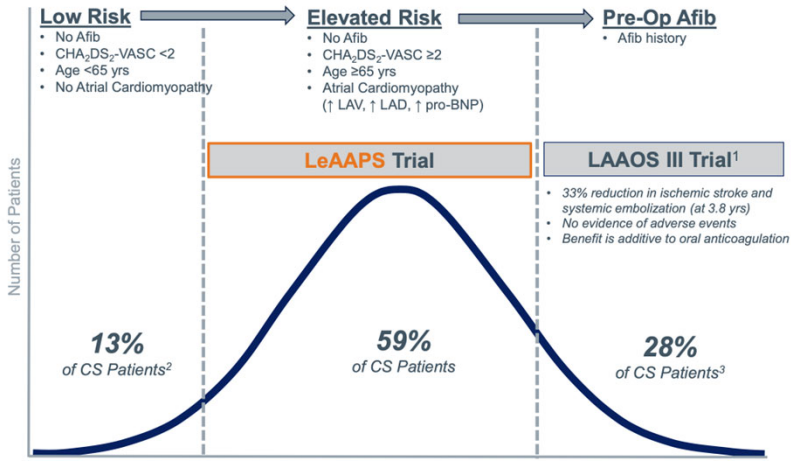
42

LEAAPS Trial



43

Risk Stratification in Cardiac Surgery Patients

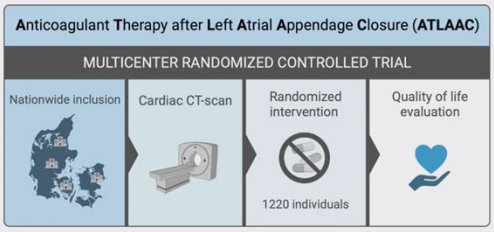


44

ATLAAC Trial

Can patients with atrial fibrillation safely discontinue anticoagulant therapy after cardiac surgery?

Kristina Gosvig, Resident in Cardiac Surgery
Odense University Hospital



Recruitment expected to start Q1 2024

45

Conclusion

- Atrial fibrillation / LAA clot is an important risk factor for stroke
- LAAO is safe and effective in decreasing risk of stroke
- **There is a need to increase surgical LAAO in AF all patients**

46

Conclusion

- LAAO will be indicated on all high-risk surgical patients?
- In LAAO, will anticoagulation be needed?

Minneapolis Heart Institute Foundation | GRAND ROUNDS

47

Grand Rounds
Current state of surgical left atrial appendage exclusion
March 18, 2024

AtriCure Study

Atsushi Okada, MD, PhD
Vinayak N. Bapat, MD

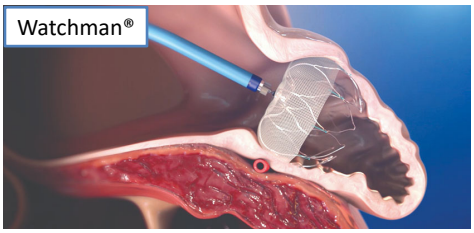
Minneapolis Heart Institute Foundation
Minneapolis Heart Institute at Abbott Northwestern Hospital

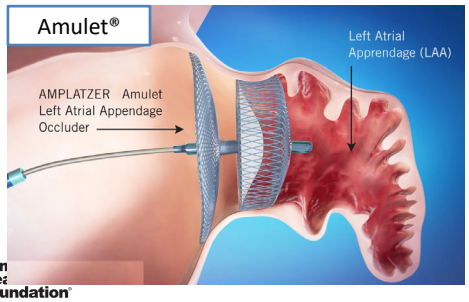
Minneapolis Heart Institute Foundation
Creating a world without heart and vascular disease

48

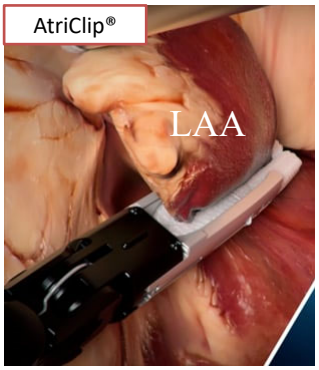
Devices to isolate the left atrial appendage

Transcatheter devices





Surgical device



Available in 4 sizes (35, 40, 45, 50 mm)

49

Device sizing is performed in different ways

Transcatheter devices

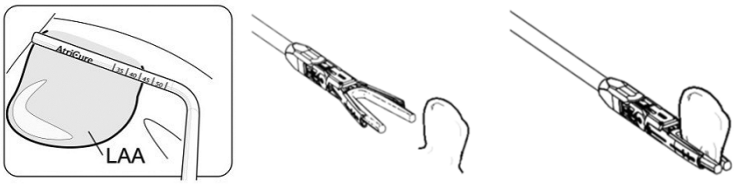
Surgical devices (AtriClip)

Device sizing by preprocedural imaging
- Transesophageal echo
- Computed tomography (CT)

Usefulness of preprocedural imaging (CT) for AtriClip sizing is unknown

50

Appropriate device sizing is crucial



- If the Clip is too small, may result in incomplete closure
- If large, Clips may interfere with the surrounding structures
  - Coronary arteries
  - Pulmonary veins

Minneapolis Heart Institute Foundation
Creating a world without heart and vascular disease

51

Aim of this study

We sought to investigate

1. Association between <u>theroretical CT-predicted size</u> and <u>implanted size during surgery</u>

2. Their association with imaging outcomes
   - findings on prospectively conducted post-AtriClip CTs

in patients undergoing AtriClip placement

Minneapolis Heart Institute Foundation
Creating a world without heart and vascular disease

52

Methods

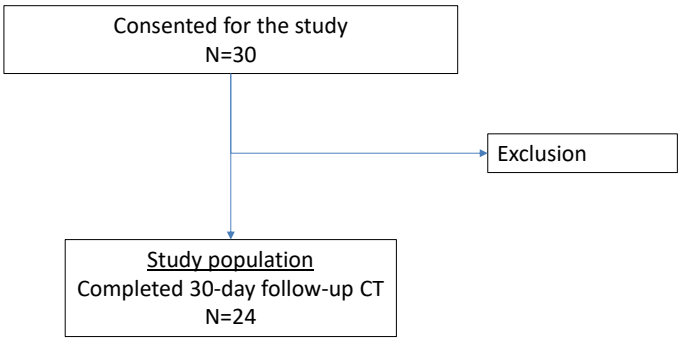
Minneapolis Heart Institute Foundation
Creating a world without heart and vascular disease

53

Methods

Study population

- Prospectively enrolled patients undergoing open heart surgery @ ANW and clinically indicated for LAA ligation with the AtriClip device



Minneapolis Heart Institute Foundation
Creating a world without heart and vascular disease

54

Methods

Evaluations

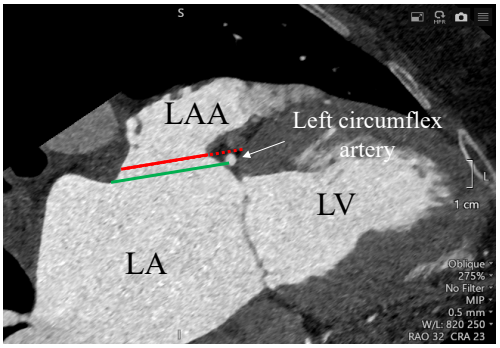
- Baseline characteristics
- Pre-AtriClip CT
- AtriClip sizing during surgery (on-table sizing)
- Post-AtriClip CT
  - at 90 days after surgery

Minneapolis Heart Institute Foundation
Creating a world without heart and vascular disease

55

Methods

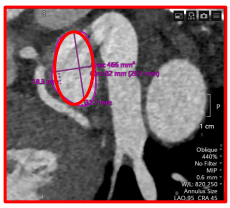
Pre-AtriClip CT 1



LA: left atrium
LAA: left atrial appendage
LV: left ventricle

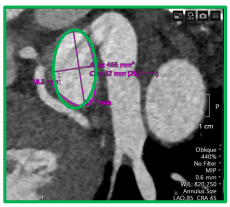
"Clip Plane"

- Parallel to the LAA ostium
- Above (distal to) the left circumflex artery
- Area and perimeter in short axis view



LAA Ostium

- At the base of LAA
- Area and perimeter in short axis view

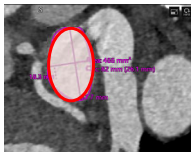


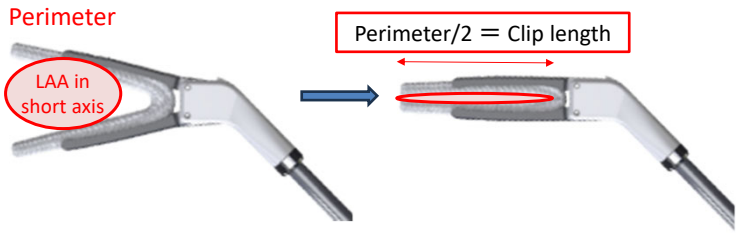
Minneapolis Heart Institute Foundation
Creating a world without heart and vascular disease

56

Methods

CT-predicted AtriClip size





Perimeter at Clip plane	Perimeter/2	CT suggested AtriClip® Flex-V® size
70.0 mm or smaller	35.0 mm or smaller	35 (smallest available)
70.1 - 80.0 mm	35.1 - 40.0 mm	40
80.1 - 90.0 mm	40.1 - 45.0 mm	45
90.1 mm or larger	45.1 mm or larger	50 (largest available)

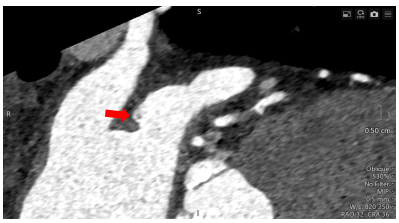
Minneapolis Heart Institute Foundation
Creating a world without heart and vascular disease

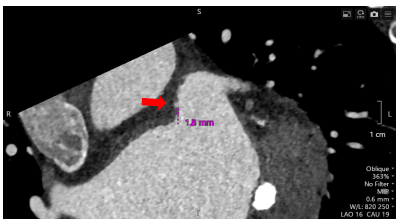
57

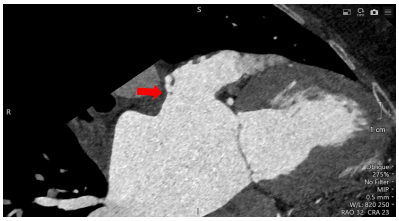
Methods

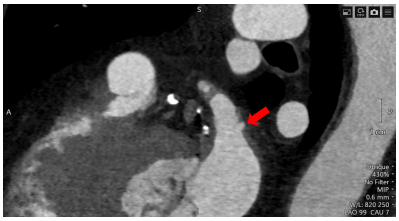
Pre-AtriClip CT 2

- Trabeculation/lobe near Clip plane (<5 mm)









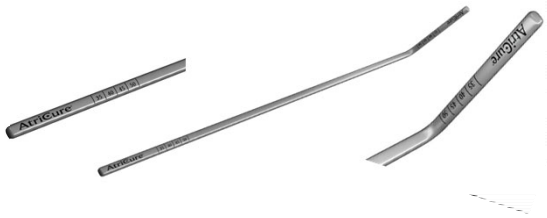
Minneapolis Heart Institute Foundation
Creating a world without heart and vascular disease

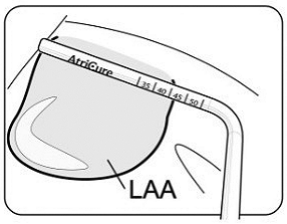
58

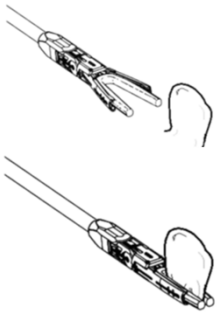
Methods

AtriClip size during surgery

- On-table sizing by sizers: implanted Clip ($_{IM}$Clip)







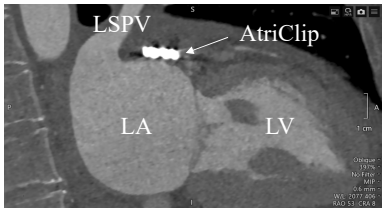
- Comparison with CT-predicted size
  - $_{IM}$Clip < $_{CT}$Clip: on-table size was <u>smaller</u> than CT-predicted size
  - $_{IM}$Clip = $_{CT}$Clip: on-table size was <u>same</u> as CT-predicted size
  - $_{IM}$Clip > $_{CT}$Clip: on-table size was <u>larger</u> than CT-predicted size

Minneapolis Heart Institute Foundation
Creating a world without heart and vascular disease

59

Methods

Post-AtriClip CT 1



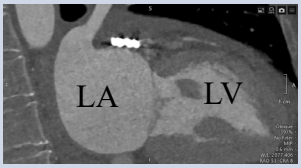
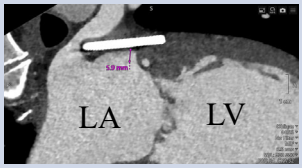
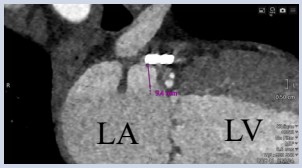
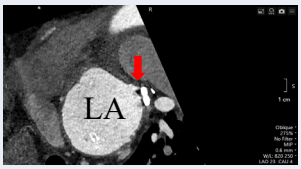
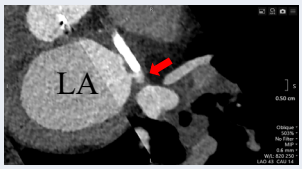
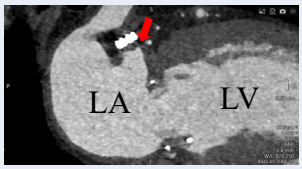
- Complete occlusion of LAA (No Contrast in LAA)
- Thrombus formation at atrial side of Clip

Minneapolis Heart Institute Foundation
Creating a world without heart and vascular disease

60

Methods

Post-AtriClip CT 2

	Stump depth <10 mm		Stump depth >10 mm
Trabeculation/lobe in stump (-)			
Trabeculation/lobe in stump (+)			

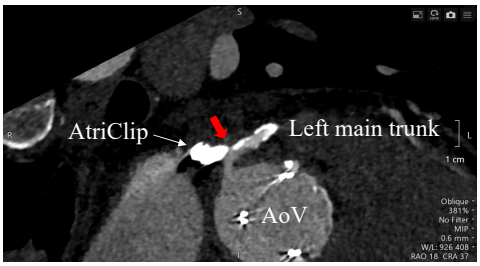
Minneapolis Heart Institute Foundation
Creating a world without heart and vascular disease

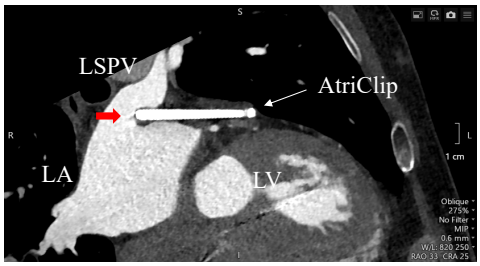
61

Methods

Post-AtriClip CT 3

- Clip interference with surrounding structures
  - coronary arteries (left main trunk, left circumflex artery)
  - left superior pulmonary vein





AoV: aortic valve

LA: left atrium
LV: left ventricle
LSPV: left superior pulmonary vein

Minneapolis Heart Institute Foundation
Creating a world without heart and vascular disease

62

Results

Minneapolis Heart Institute Foundation
Creating a world without heart and vascular disease

63

Results

Patient Characteristics

	N=24
Age, years	69 (61-77)
Male	15 (63%)
Body surface area, m^2	2.02 (1.81-2.17)
Atrial fibrillation	9 (38%)
Surgical data	
AtriClip size, mm	
35	6 (25%)
40	9 (38%)
45	4 (17%)
50	5 (21%)
Procedures*	
Aortic valve surgery	11 (46%)
Mitral valve surgery	10 (42%)
Tricuspid valve surgery	3 (13%)
Coronary artery bypass grafting	7 (29%)
Ascending aorta replacement	1 (4%)

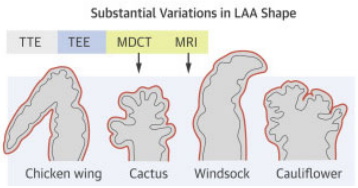
Minneapolis Heart Institute Foundation
Creating a world without heart and vascular disease

64

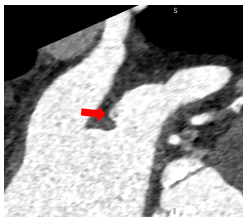
Results

Pre-AtriClip CT

	N=24
LAA shapes	
Chicken wing	9 (38%)
Cactus	3 (13%)
Windsock	9 (38%)
Cauliflower	3 (13%)
Ostium	
Area, mm^2	519 (423-676)
Perimeter, mm	87 (79-103)
Clip plane	
Area, mm^2	449 (384-613)
Perimeter, mm	80 (72-92)
Trabeculation/lobe near Clip plane	12 (50%)



JACC Cardiovasc Imaging 2015; 8: 472-488.



Minneapolis Heart Institute Foundation
Creating a world without heart and vascular disease

65

Results

Post CT 1

	N=24
Complete occlusion of LAA	24 (100%)
Thrombus formation at Clip	0 (0%)
Residual stump	
depth >10mm	6 (25%)
depth <10mm	18 (75%)
Trabeculation/lobe in stump	
Yes	12 (50%)
No	12 (50%)

	Stump depth >10 mm N=6	Stump depth <10 mm N=18
Trabeculation/lobe in stump (-)	3 (50%)	9 (50%)
Trabeculation/lobe in stump (+)	3 (50%)	9 (50%)

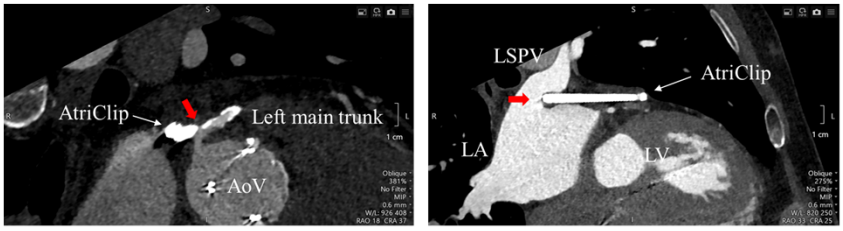
Minneapolis Heart Institute Foundation
Creating a world without heart and vascular disease

66

Results

Post CT 2

	N=24
Clip interference with surrounding anatomy	
Proximity with Left main trunk	1 (4%)
Proximity with Left circumflex artery (LCx)	0 (0%)
Proximity with Left superior pulmonary vein	4 (17%)



AoV: aortic valve

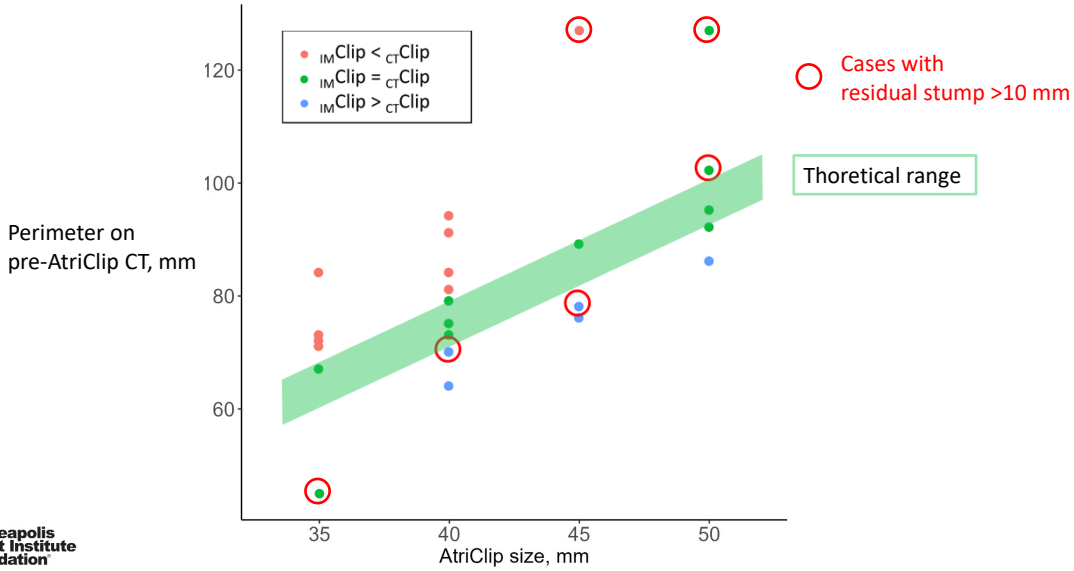
LA: left atrium
LV: left ventricle
LSPV: left superior pulmonary vein

Minneapolis Heart Institute Foundation
Creating a world without heart and vascular disease

67

Results

AtriClip size during surgery vs. CT-predicted size



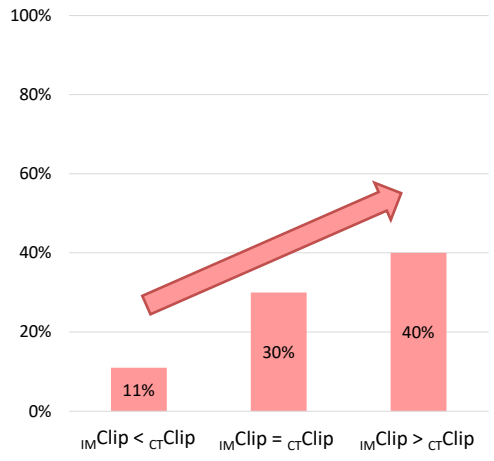
Minneapolis Heart Institute Foundation
Creating a world without heart and vascular disease

68

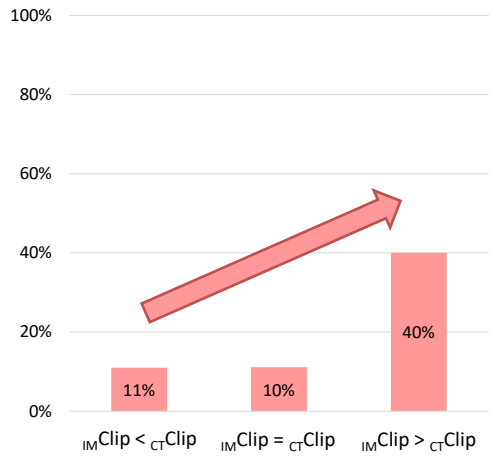
Results

Factors associated with size discrepancy

Rates of residual stump (>10 mm)



Proximity with left superior pulmonary vein



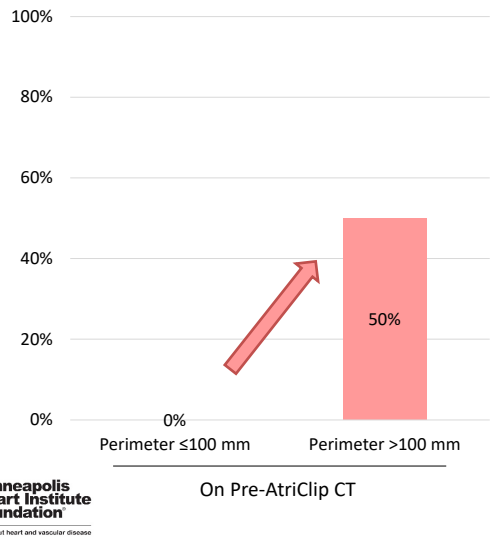
Minneapolis Heart Institute Foundation
Creating a world without heart and vascular disease

69

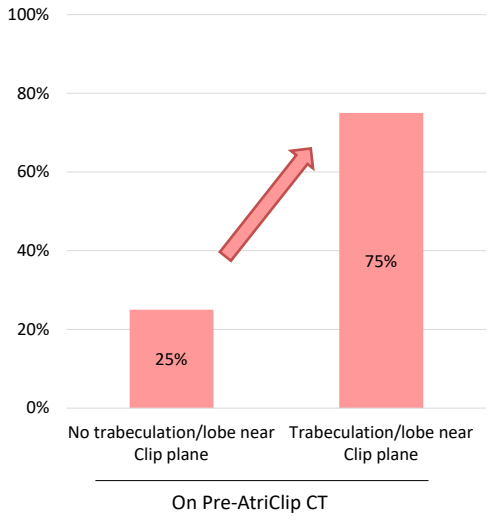
Results

Can we predict imaging outcomes from pre-AtriClip CT?

Rates of residual stump (>10 mm)



Residual trabeculation/lobe in stump



Minneapolis Heart Institute Foundation
Creating a world without heart and vascular disease

70

Conclusions

- AtriCure study is a prospective evaluation of pre- and post-CTs in patients undergoing LAA elimination using AtriClip device
- Both pre- and post-CTs can provide important information which could contribute to better outcomes

Minneapolis Heart Institute Foundation
Creating a world without heart and vascular disease

71

Thank you for your attention

Minneapolis Heart Institute Foundation®
Creating a world without heart and vascular disease

Minneapolis Heart Institute Foundation
Creating a world without heart and vascular disease

72

73