KHRS 2021 The 13th Annual Scientific Session of the Korean Heart Rhythm Society

LAA: Anatomy, Image and Clinical Significance

Name

Jung Myung Lee, MD, PhD

Cardiology Division, Cardiovascular Center
Kyung Hee University College of Medicine,
Seoul, Korea

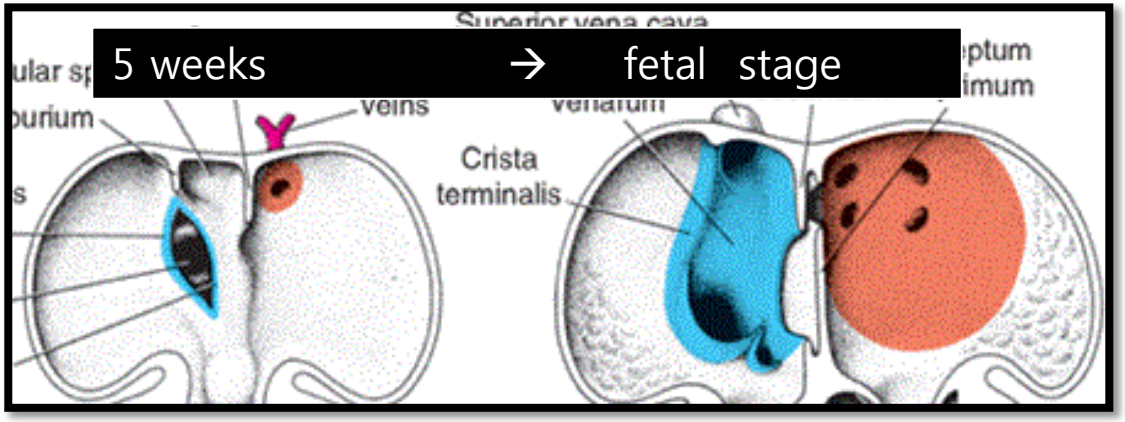
Korean Heart Rhythm Society
COI Disclosure

Name of First Author: Jung Myung Lee

The authors have no financial conflicts of interest to disclose concerning the presentation

Assessment of LAA: Anatomy & embryology of LAA

- Long, tubular, hooked, finger-like structure
- Variable morphology and size
- Orifice
  - Diameter: 10~40 mm
  - Between LSPV and mitral annulus
- Length: 16~51 mm
- Pectinated muscle
- Actively contractile



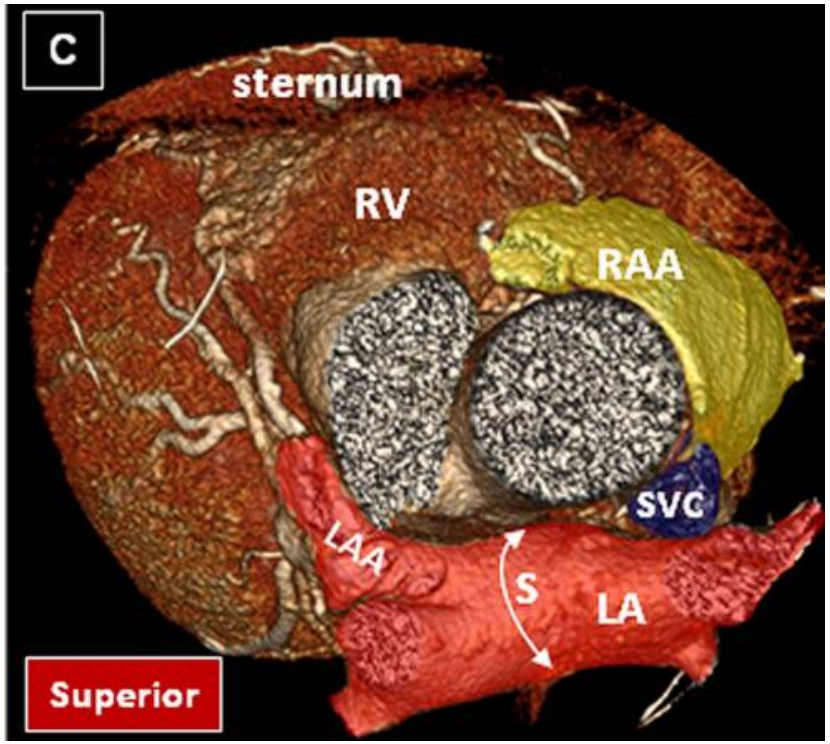
Original embryonic LA → LAA

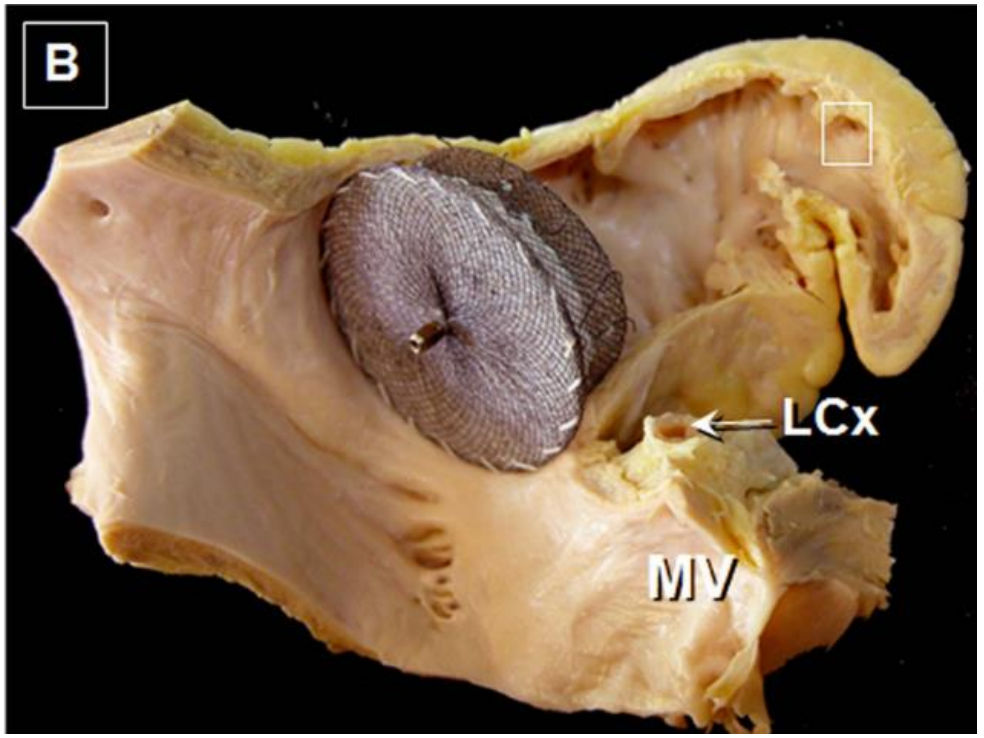
Pulmonary vein → smooth-walled LA

Langman's medical embryology, chapter 13, 12th edition

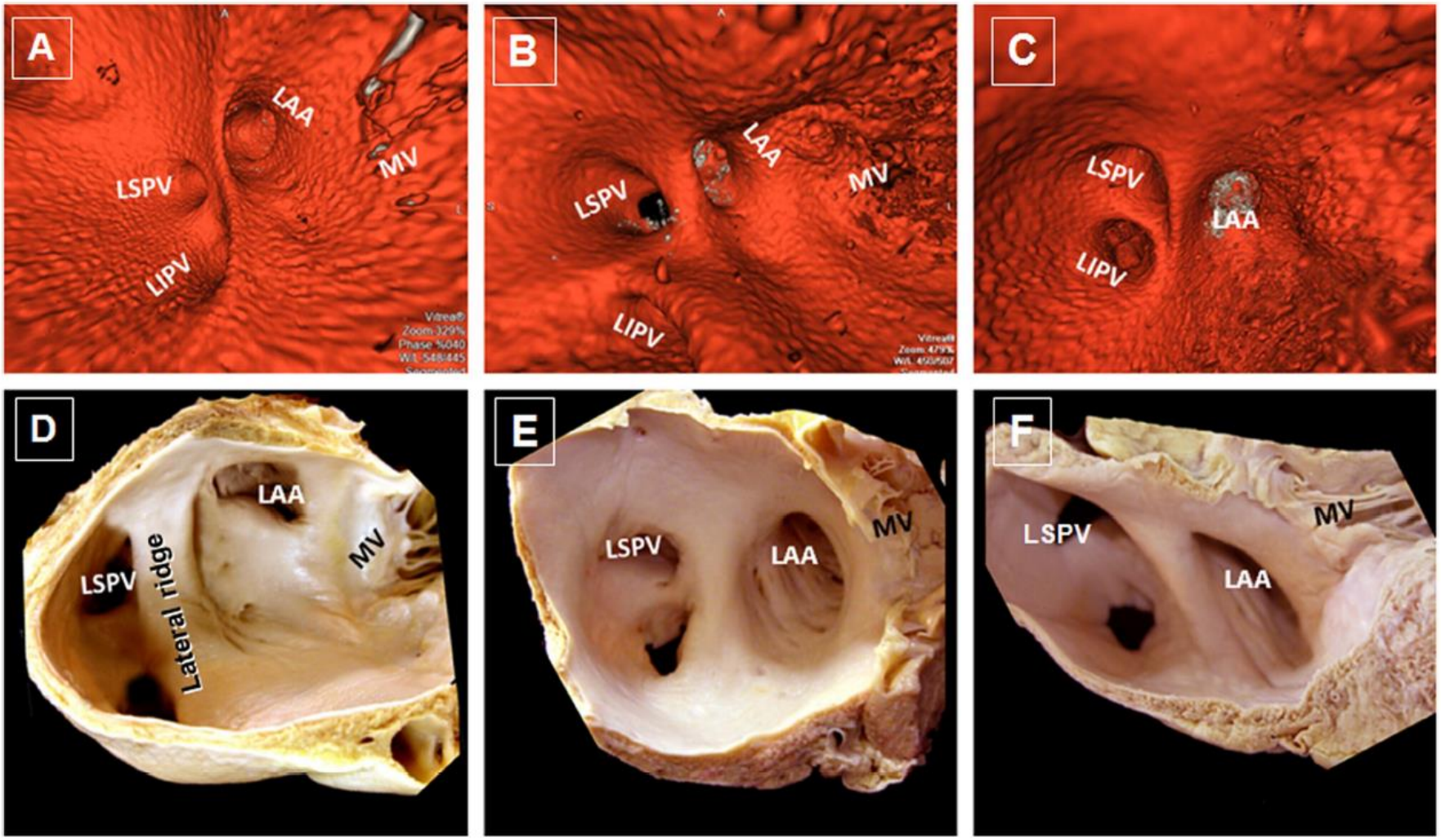
J Atr Fibrillation. 2015 ; 8(2): 81–87.

LAA and adjacent structures

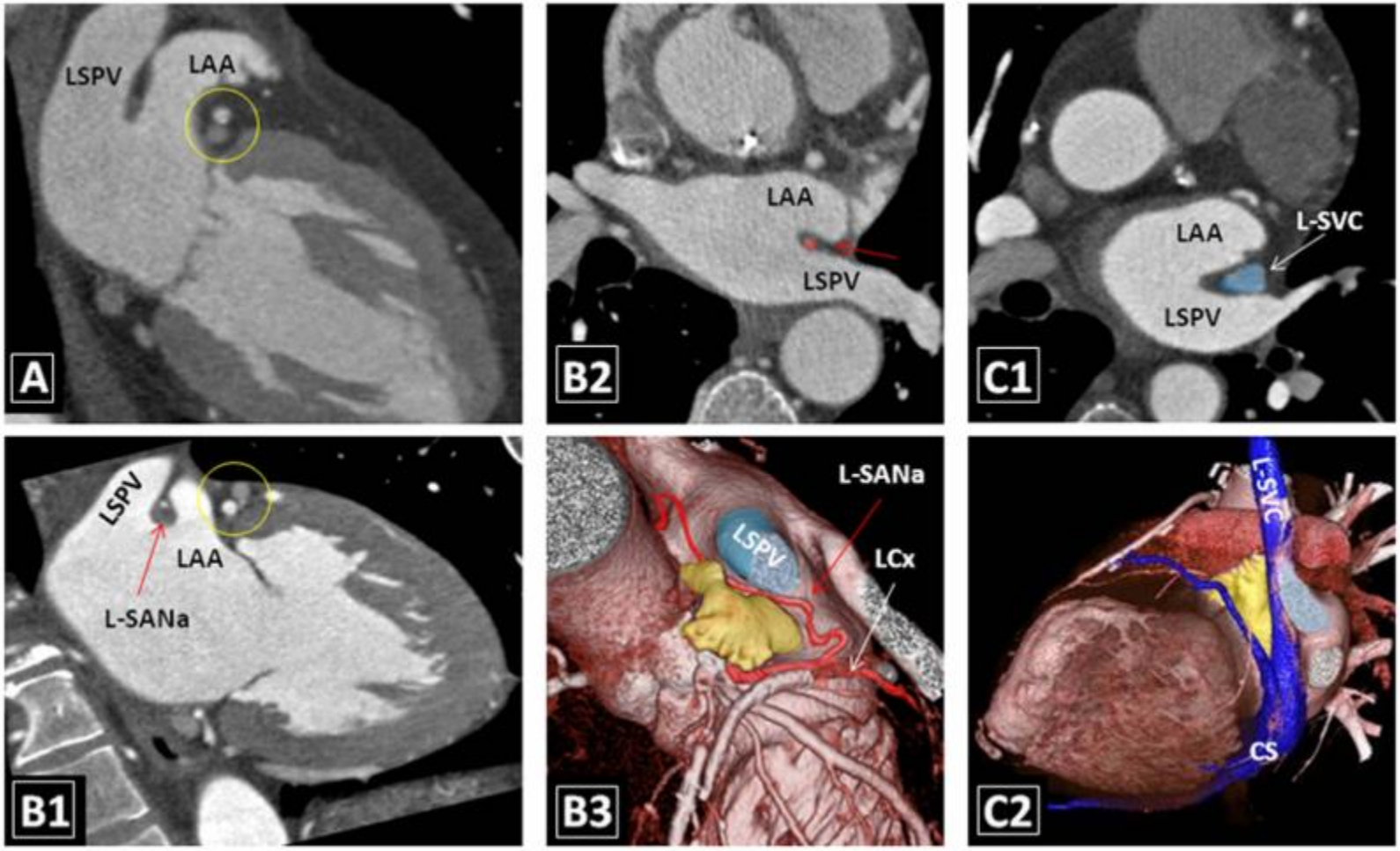




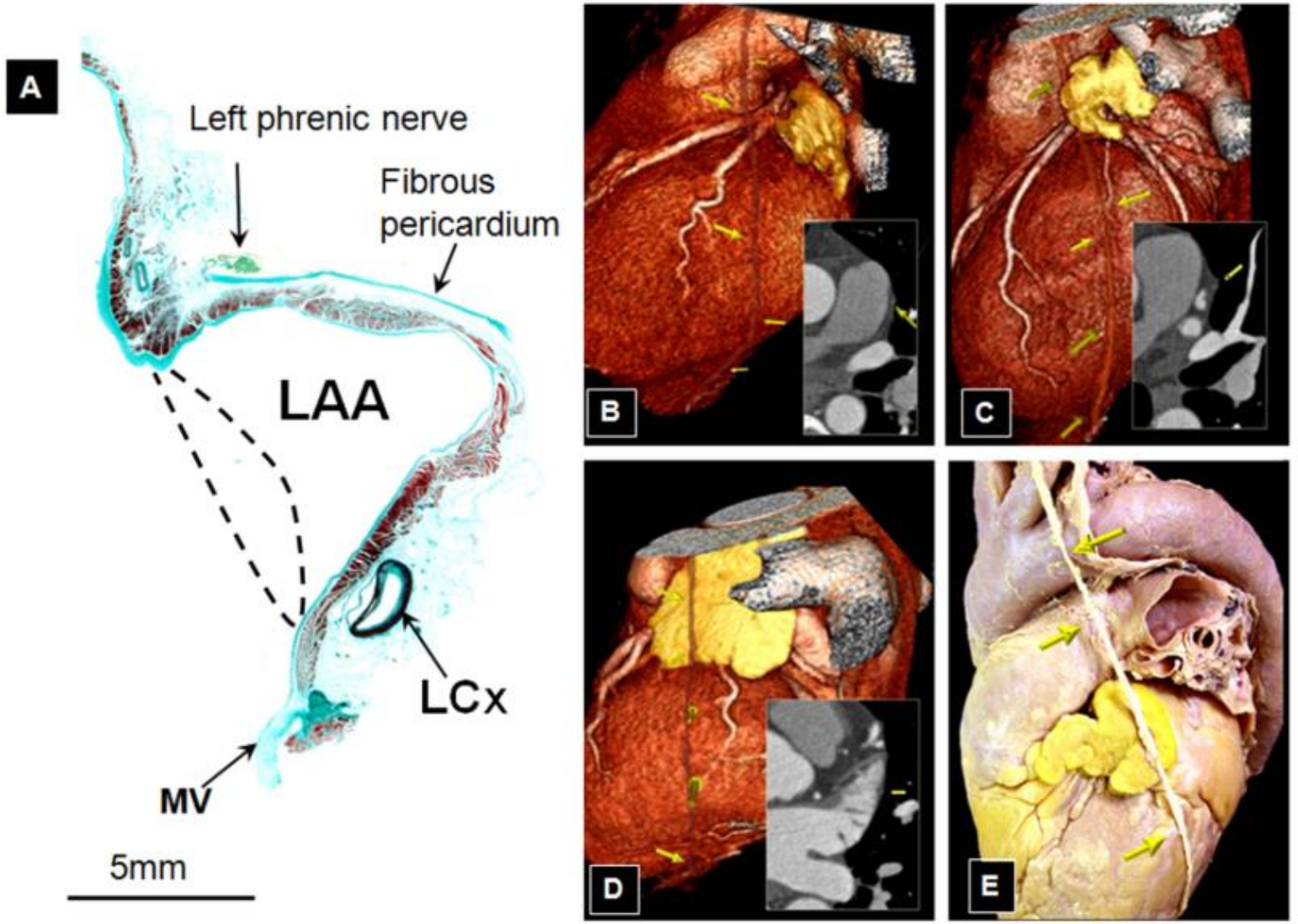
Heart 2014;100:1636–1650


A
LAA
MV
LSPV
LIPV
B
LAA
MV
LSPV
LIPV
C
LSPV
LAA
LIPV
D
LAA
MV
LSPV
Lateral ridge
E
LSPV
LAA
MV
F
LSPV
MV
LAA

LAA and adjacent structures



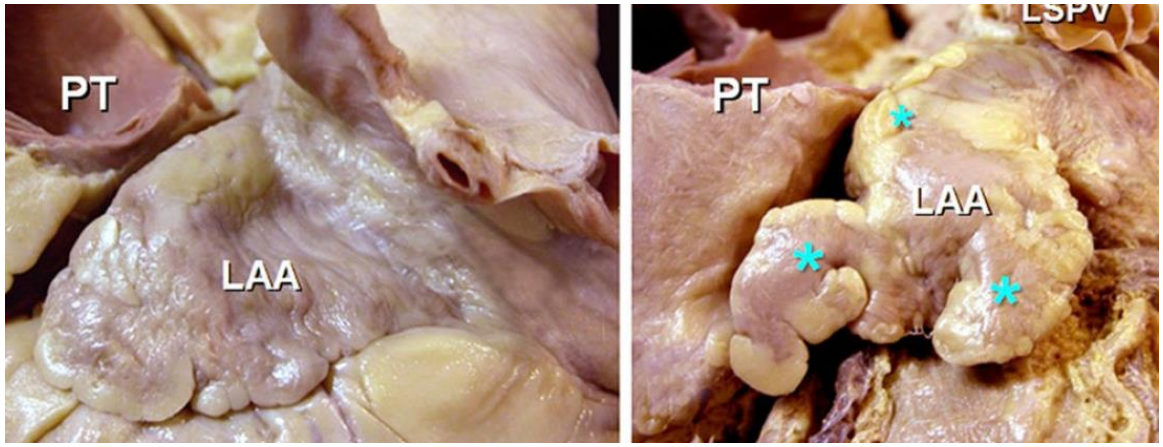
LAA and phrenic nerve



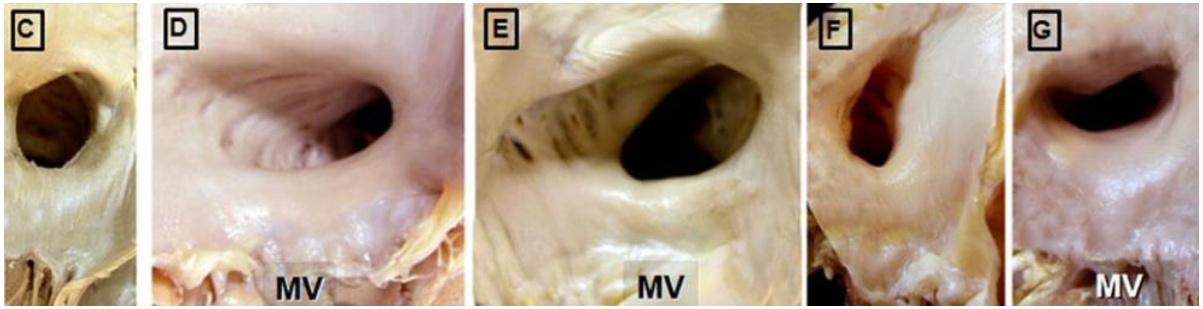
overlying the tip of the appendage in 59% of hearts and over the neck of the appendage in 23%

Anatomical variations of LAA

- Heavy trabeculation, multi-lobed (80%)



- Various morphology of ostium

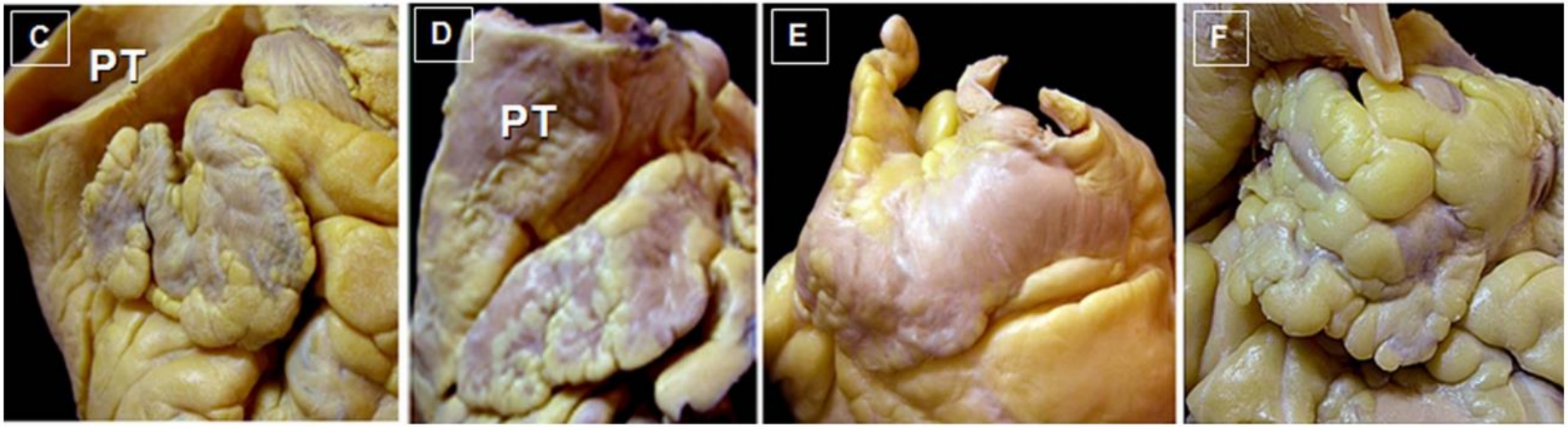


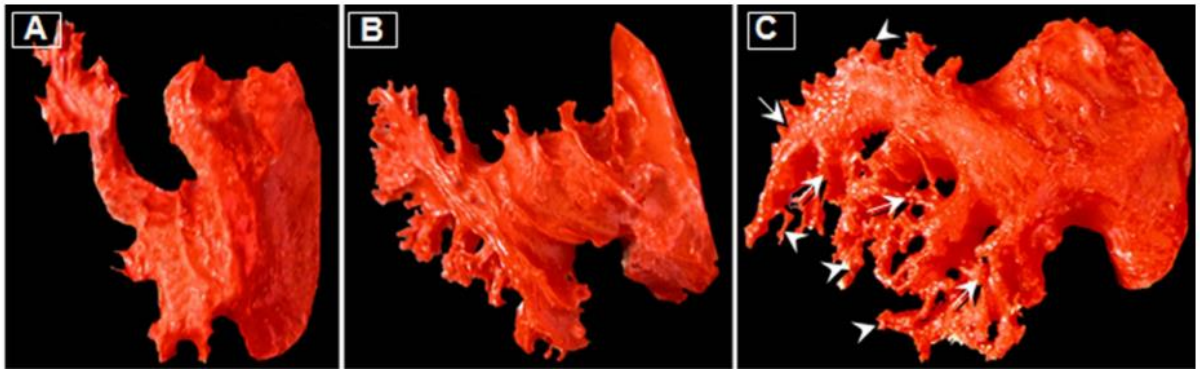
oval (68.9%), foot-like (10%), triangular (7.7%), water drop-like (7.7%), and round (5.7%).

Heart 2014;100:1636–1650.
J Atr Fibrillation. 2015 ; 8(2): 81–87.

LAA morphologies

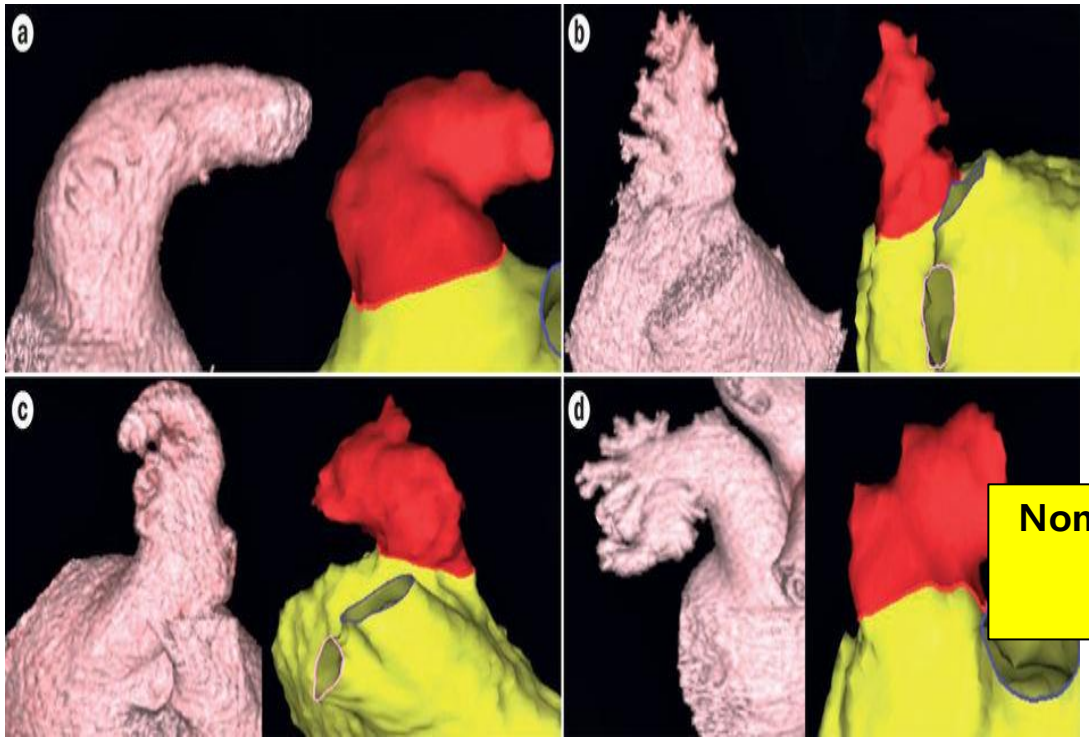
Chicken wing windsock cactus cauliflower

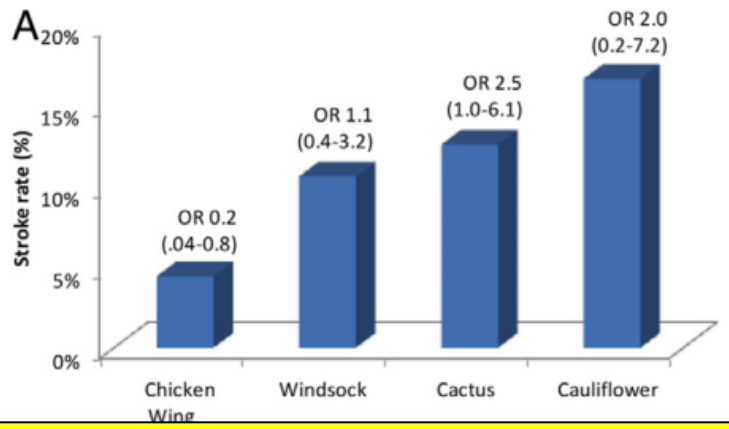




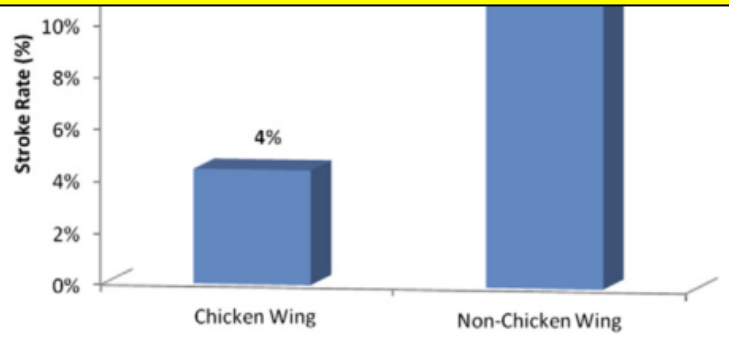
Heart 2014;100:1636–1650

LAA morphology and stroke





Non-Chicken wing morphology was associated with Higher Hx of stroke/TIA

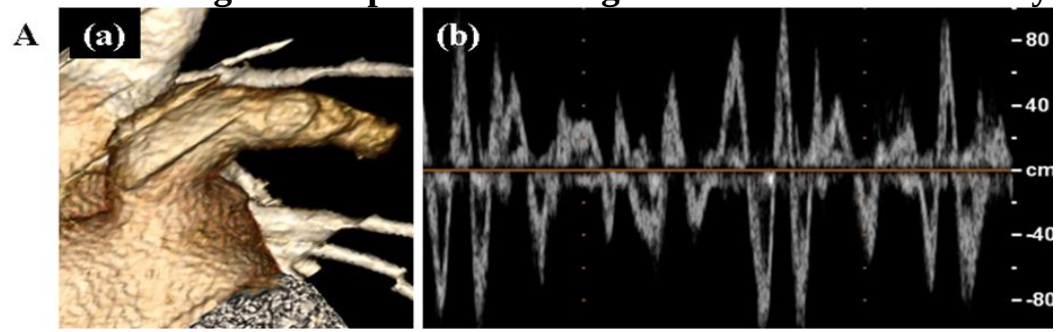


932 pts with AF
CT or MRI before RFCA
Retrospective, cross sectional design (odds ratio)
Anticoagulation status – unknown
LAA velocity and size were not associated to stroke, in this data.

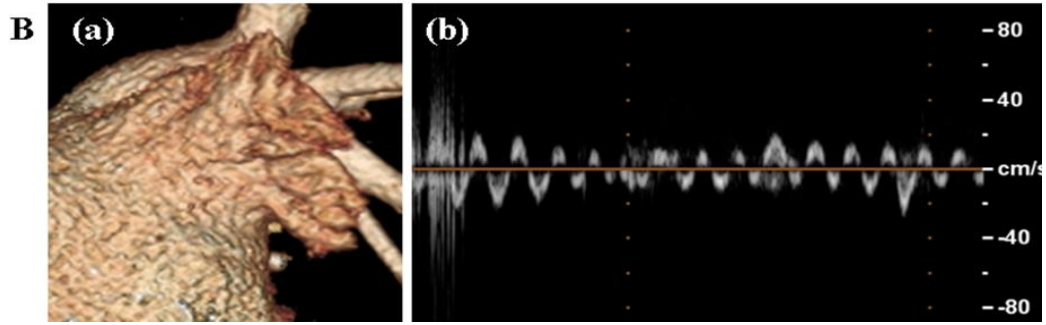
L. Di Biase, et al. J Am Coll Cardiol 2012:60;531-8

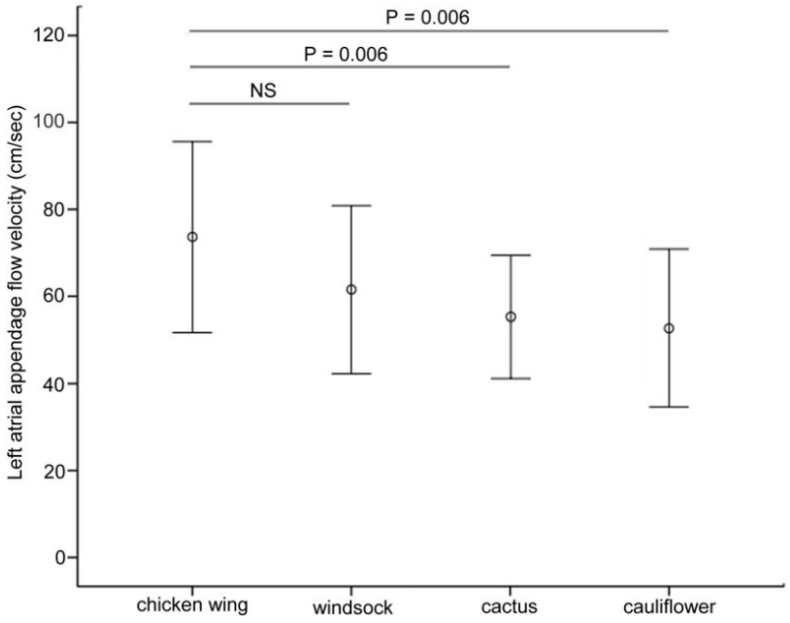
LAA morphology is associated to LAA flow velocity by TEE.

Chicken Wing LAA of patient showing normal LAA flow velocity.

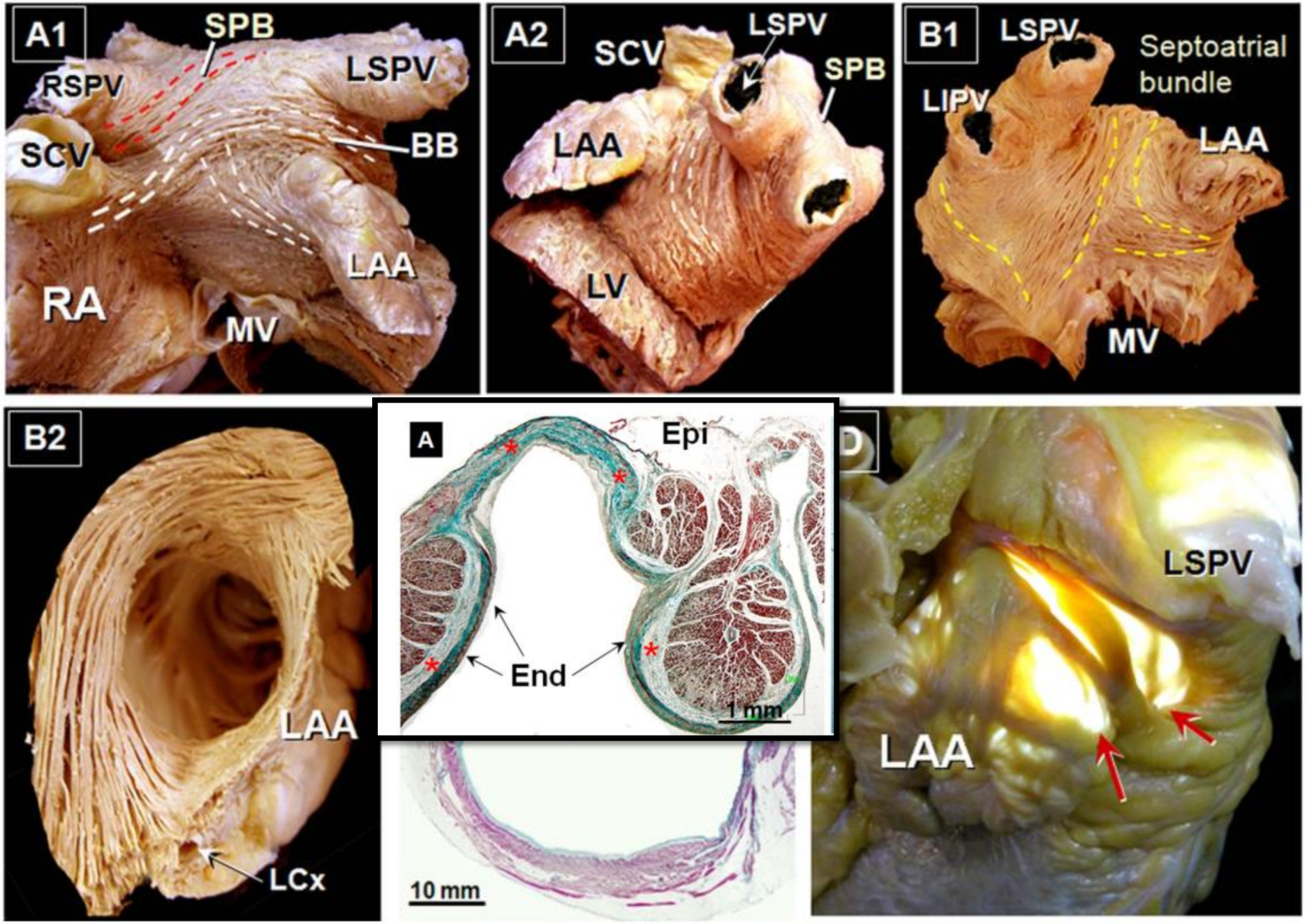


Cauliflower type LAA with decreased LAA flow velocity





Lee JM, Seo J et al. J Cardiovasc Electrophysiol, 2015:26;922-927
H Kishima, et al. Circ J 2015;79:1706-1711
K Fukushima, et al. European Heart Journal-Cardiovascular Imaging 2016:17;59-66


A1
SPB
RSPV
LSPV
SCV
BB
LAA
RA
MV
A2
LSPV
SCV
SPB
LAA
LV
B1
LSPV
Septoatrial bundle
LIPV
LAA
MV
B2
LAA
LCx
A
Epi
End
1 mm
10 mm
D
LSPV
LAA

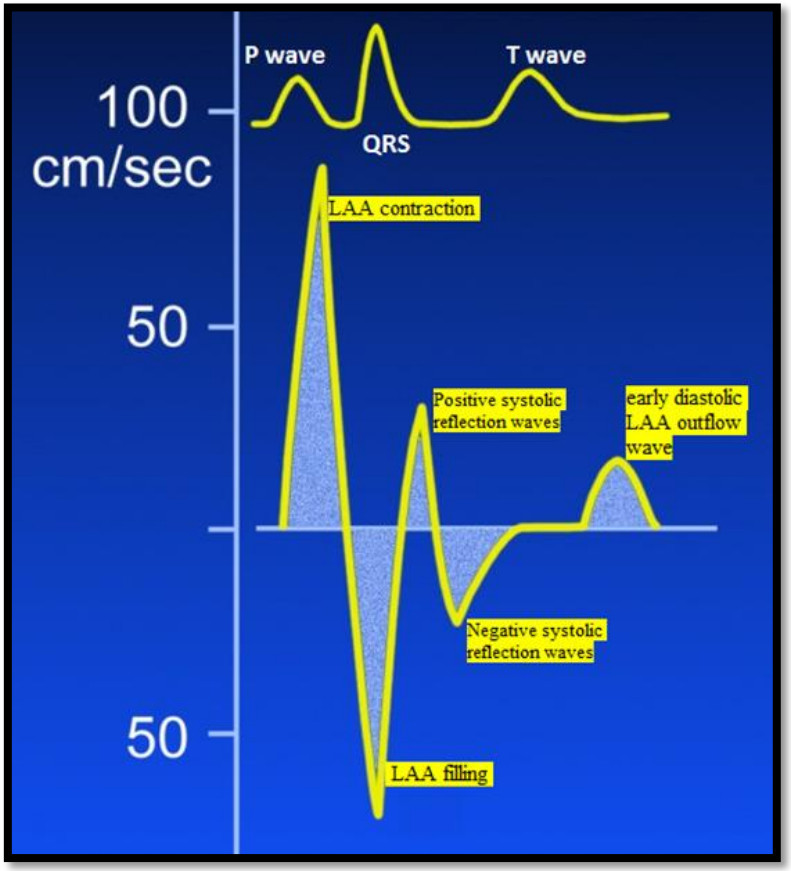
Physiologic role of LAA

- LAA is more distensible than LA
  - Decompression chamber
  - Animal experiment: Eliminating LAA ► LA pr.↑
- Mediate thirst (at least in animals)
- Removal of LAA
  - May reduce stroke volume
- Main producer of ANP in human heart
  - 40 times higher ANP than LA
  - LAA removal OP ► lower ANP, salt retention

Heart 1999;82:547–555)

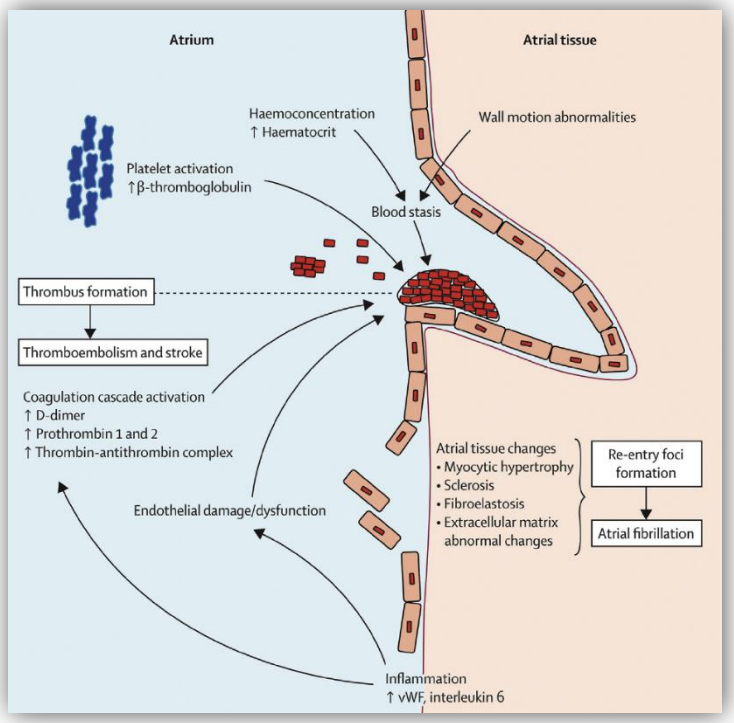
Contraction of LAA and normal LAA flow

1. Early diastolic emptying flow
2. Late diastolic contraction
   - Peak velocity
3. LAA filling
4. Systolic reflection waves



LAA as an important embolic source in NVAF

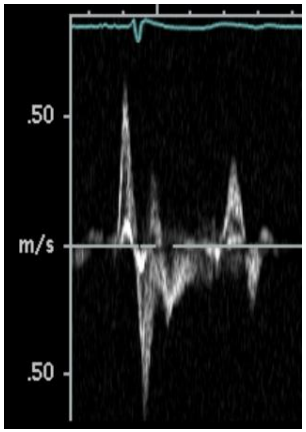
- 20% of ischemic stroke has cardiac embolic source
- AF is most common cardiac abnormality associated with stroke
- NVAF with stroke : ~90% have LAA thrombus
- 57% of thrombi in rheumatic heart disease



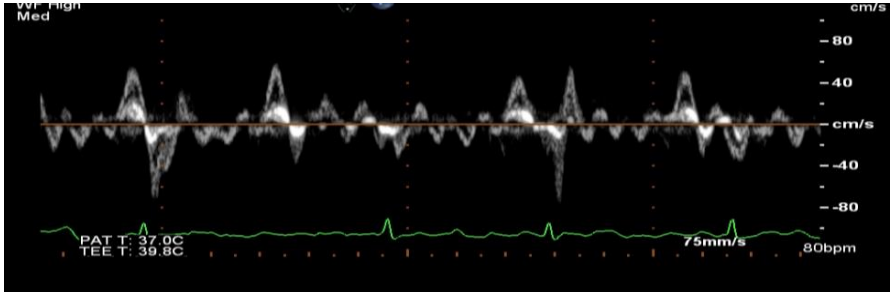
Blackshear JL, Odell JA. Ann Thorac Surg 1996;61(2):755–9.

LAA flow in NSR vs. AF

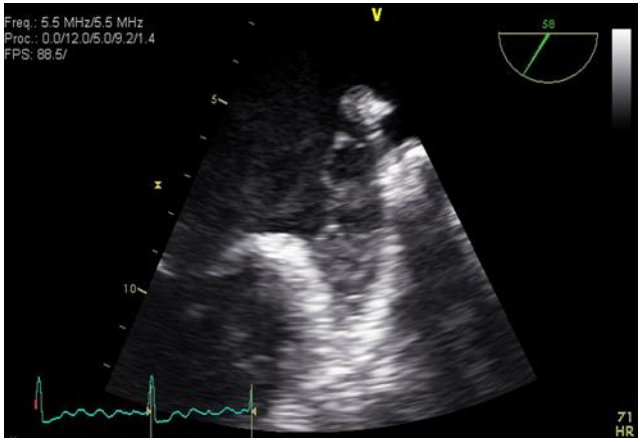
NSR

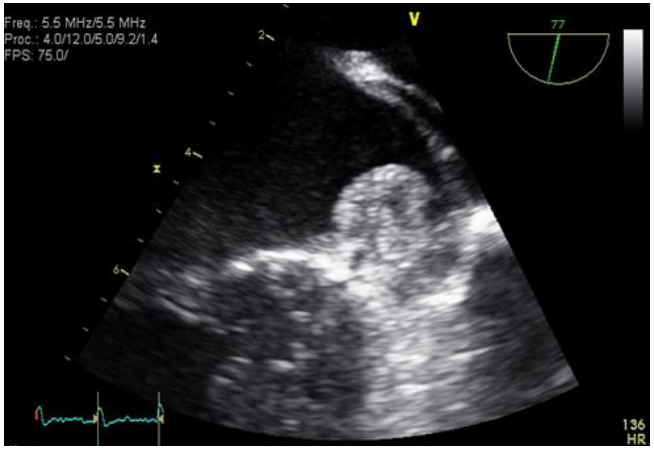


AF



Decreased LAA flow → Spontaneous echocontrast/thrombus → increased stroke

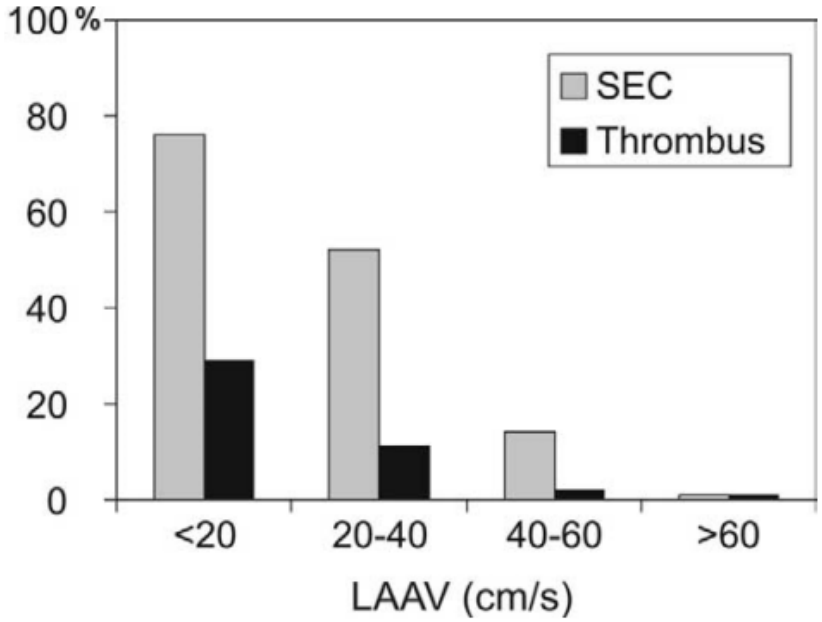




Decreased LAA peak velocity and SEC/thrombus/stroke

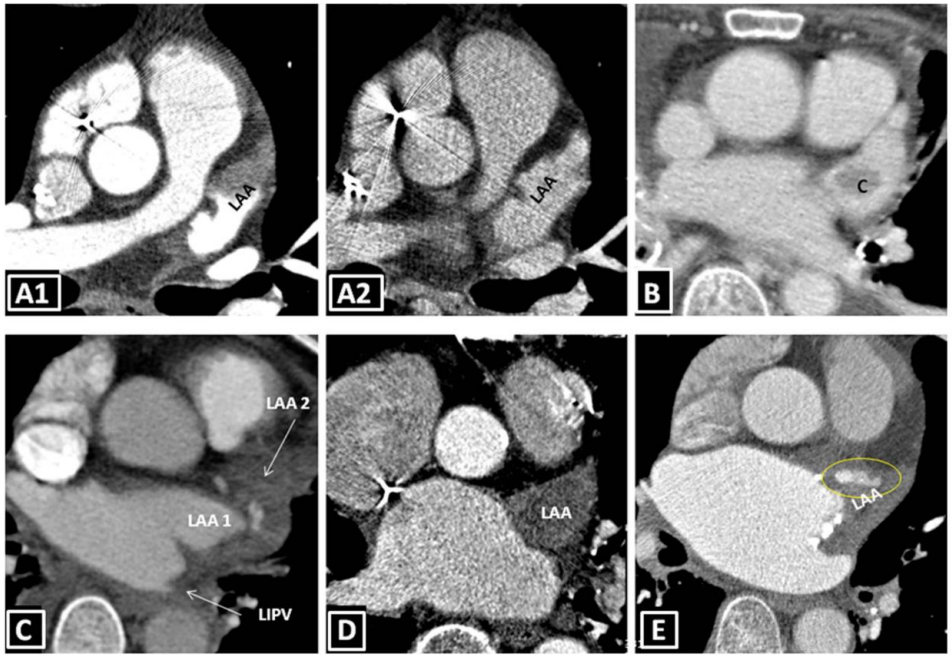
A lot of observation data demonstrated the association between low LAA velocity and SEC/thrombus/stroke

- Various cut off value
- SEC increased when LAAV<35 cm/s
  - (J Am Coll Cardiol 1994;23:961-9)
- Thrombus/SEC increased significantly at an LAAV < 55 cm/s (JASE 2005;18:1366-72)
- LAA peak velocity<20 cm/s
  - RR 1.7 for stroke
  - SPAF III data, J Am Coll Cardiol 1998;31:1622–6
  - OR 4.48 for stroke in age <70
  - CHEST 2001; 120:840–846



LAA size and stroke

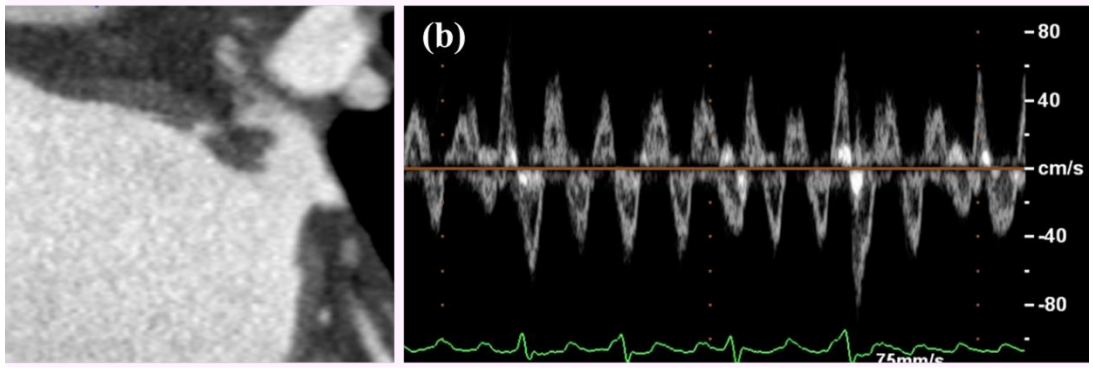
- Longer duration of AF → enlarged LAA
- Larger LAA → thrombus/stroke
  - LAA area by TEE ()
  - CT/MRI: LAA orifice size/depth/volume was associated to stroke ()
    - OR:LAA os size>>depth>volume in this study.



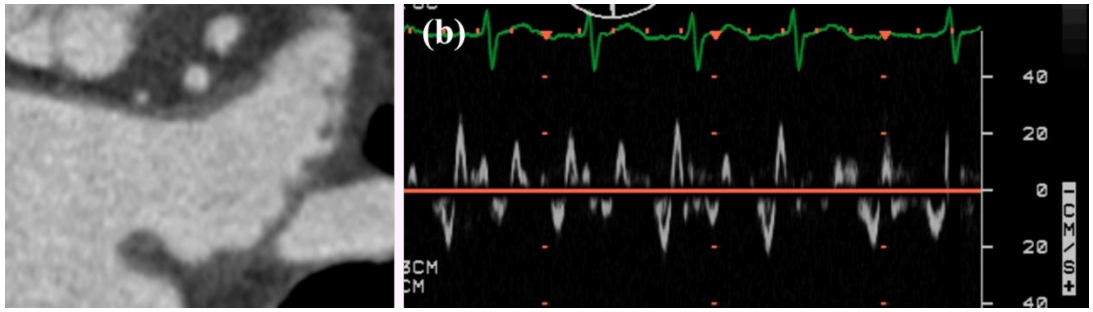
circulation 1991;84:223-231
JCE 2011;22:10-15
Heart 2014;100:1636–1650

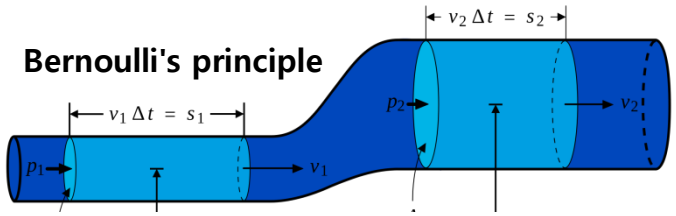
Relationship between LAA orifice size and emptying flow velocity

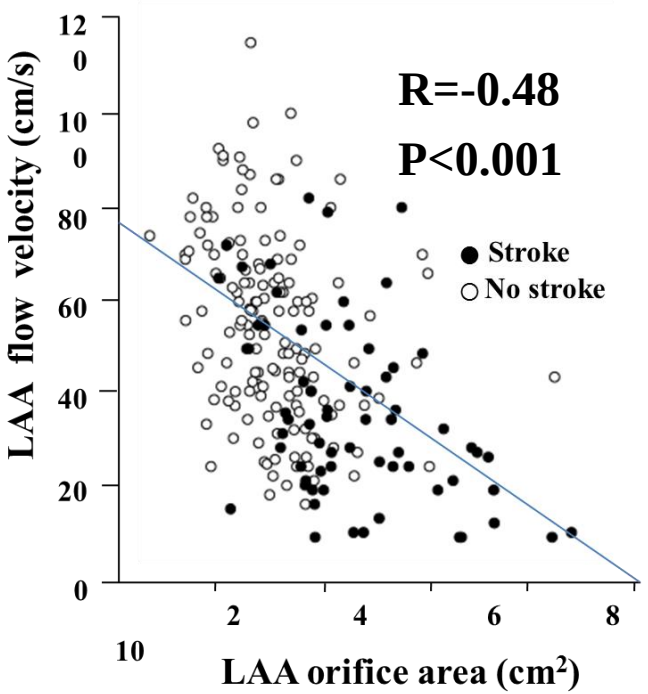
Small LAA with preserved LAA velocity



Large LAA with decreased LAA velocity



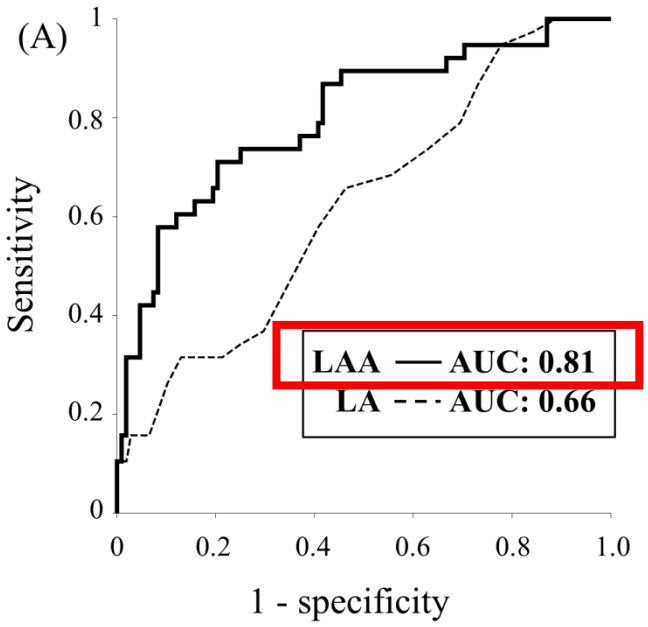




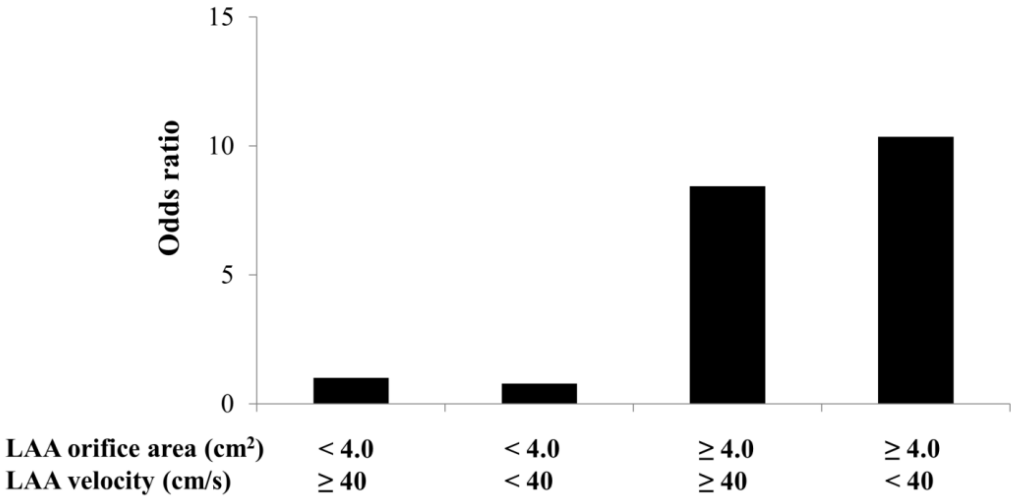
Lee JM, Joung B et al. Am J Cardiol 2014 Mar 25;113(6):963-9

Additional value of LAA for Stroke prevention in low risk patients (CHA_2DS_2VASc <2)

LAA orifice size has the largest AUC



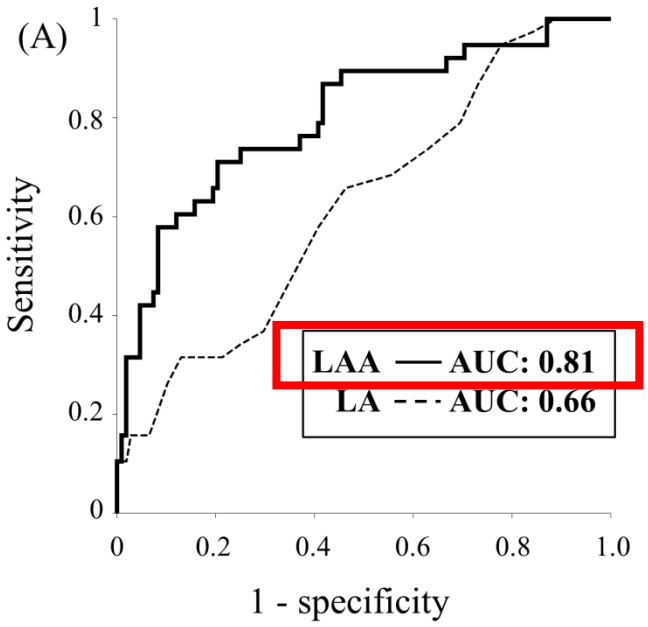
Patients with both large LAA os and low LAA velocity showed very high odds ratio of stroke



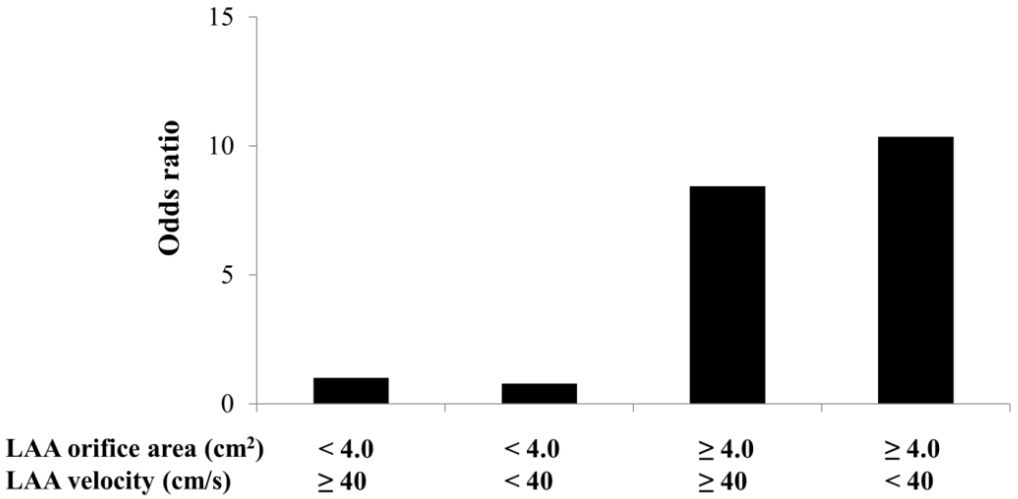
Lee JM, Joung B et al. Heart Rhythm. 2017 Sep;14(9):1297-1301.

Additional value of LAA for Stroke prevention in low risk patients (CHA2DS2VASc <2)

LAA orifice size has the largest AUC



Patients with both large LAA os and low LAA velocity showed very high odds ratio of stroke



Lee JM, Joung B et al. Heart Rhythm. 2017 Sep;14(9):1297-1301.

summary

LAA is the most common site of thrombus formation in AF

Anatomic and hemodynamic parameters of LAA, such as orifice size, volume, shape, and flow velocity is very important in assessing stroke risk.

Knowledge about LAA anatomy is very important for guiding procedure such as LAA occlusion, and for avoiding complications

The complex and diverse anatomy of LAA required a multiparamater approach.