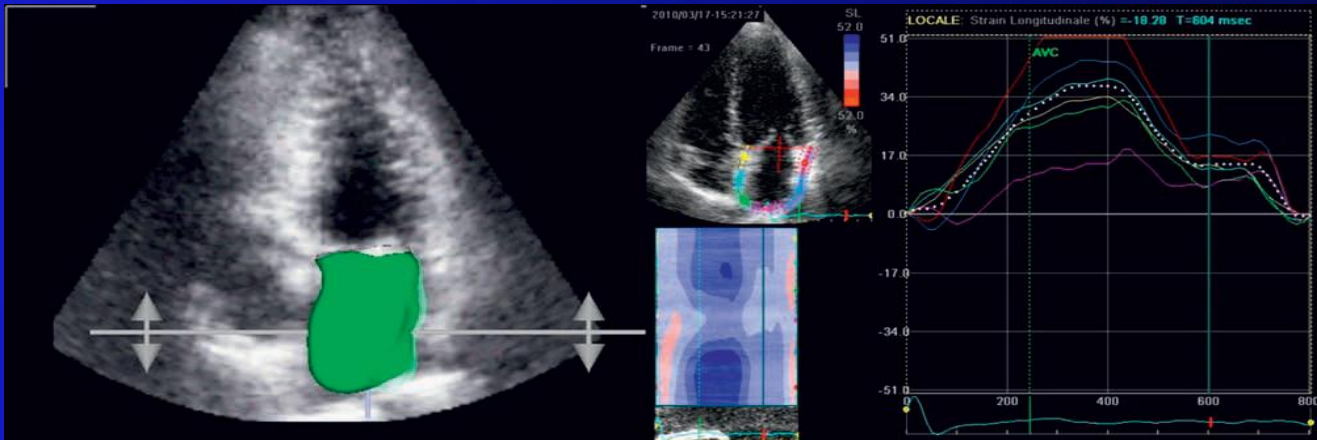


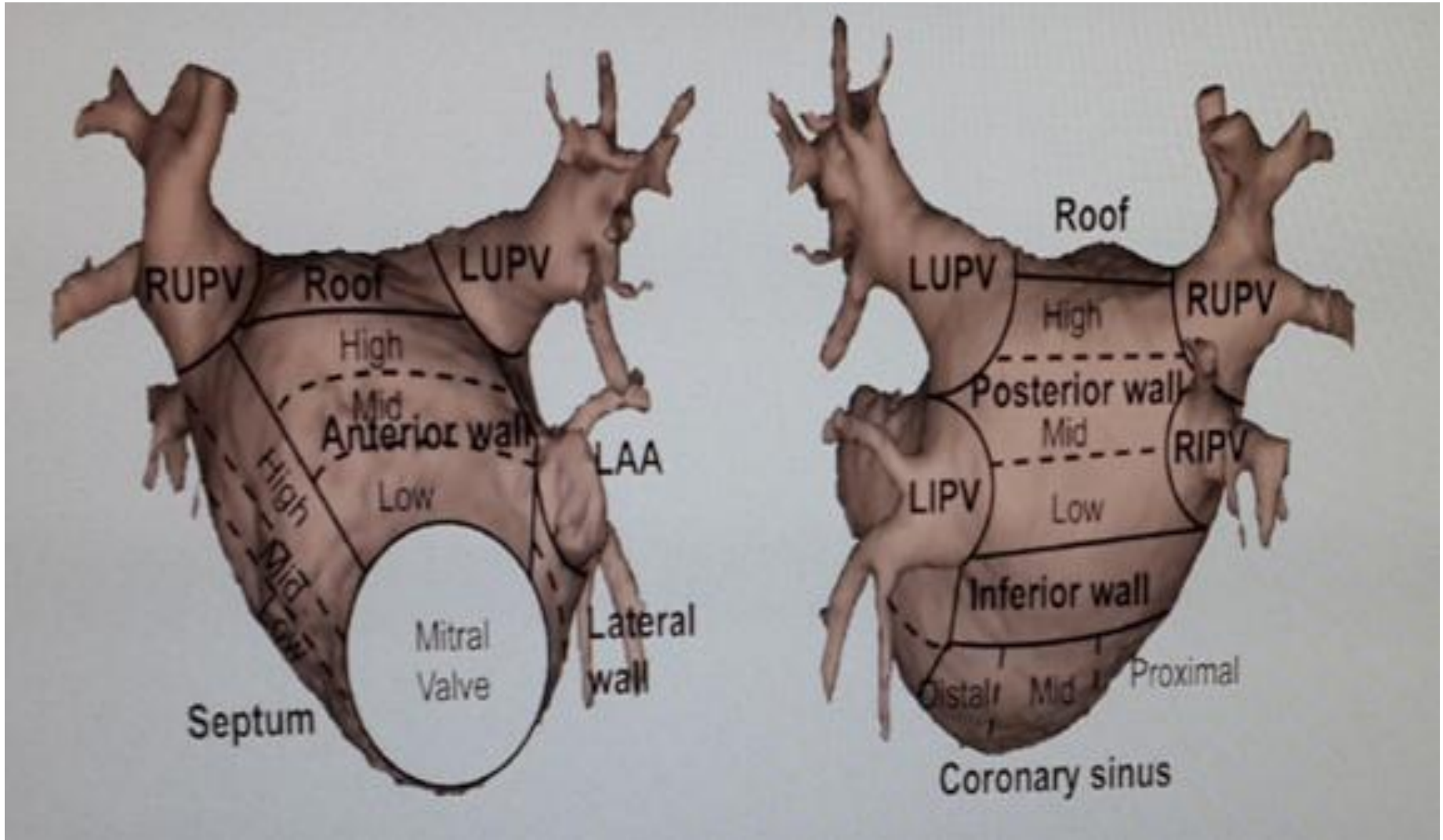
Sol Atriyum Anatomisi ve Ekokardiyografik Değerlendirmesi

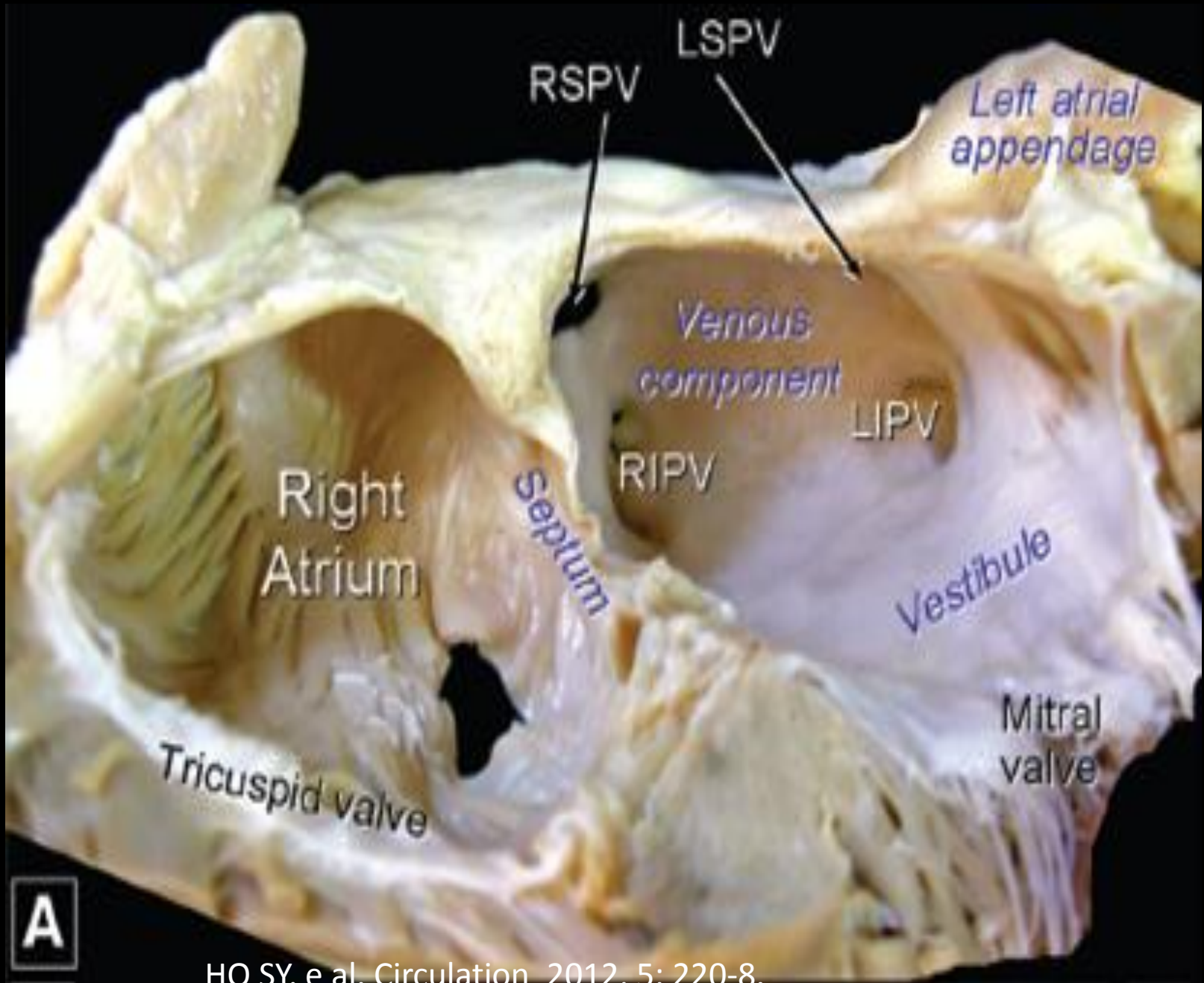
Dr. Cihangir Kaymaz

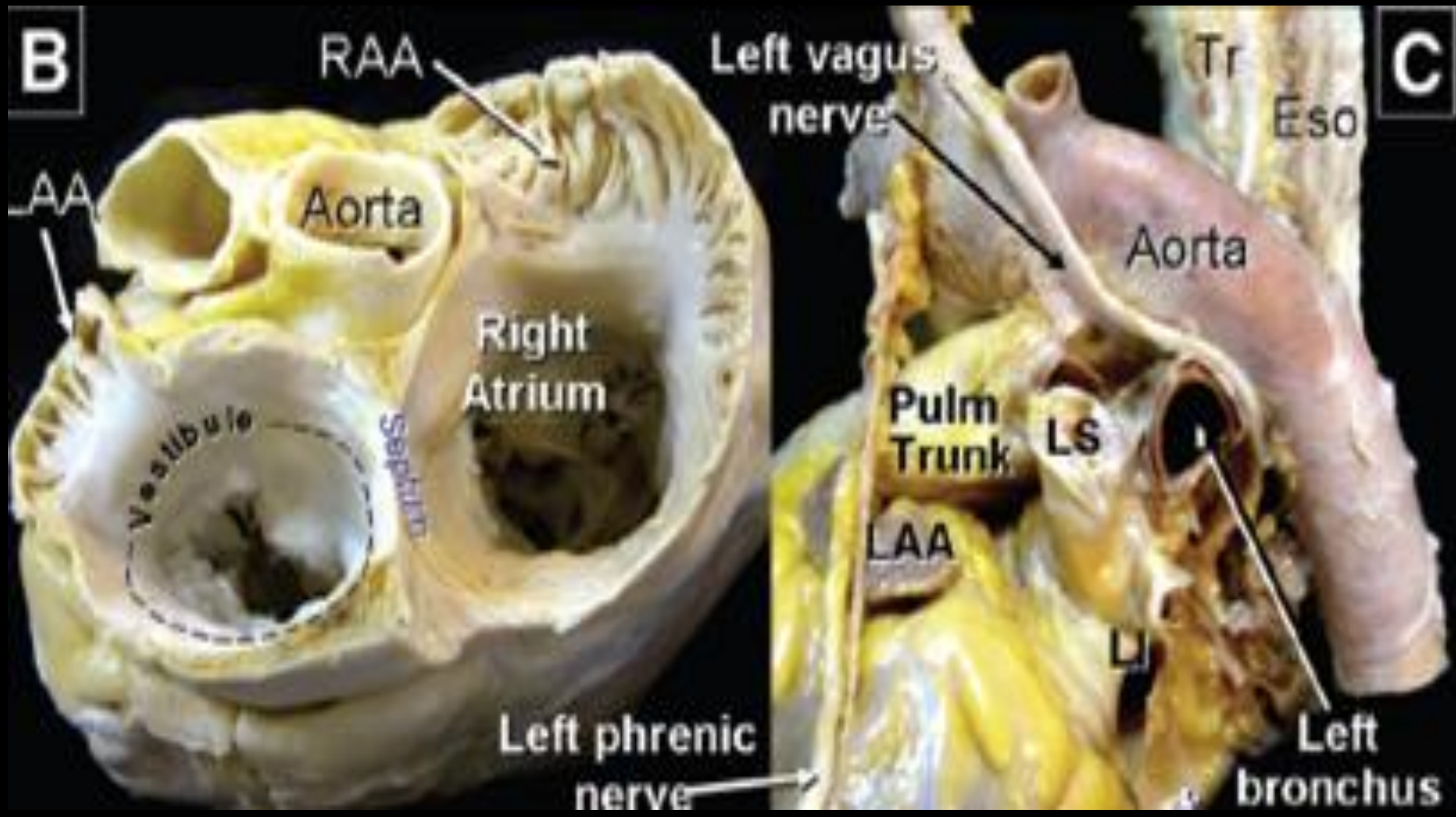
Koşuyolu YIEAH Kardiyoloji Kliniği



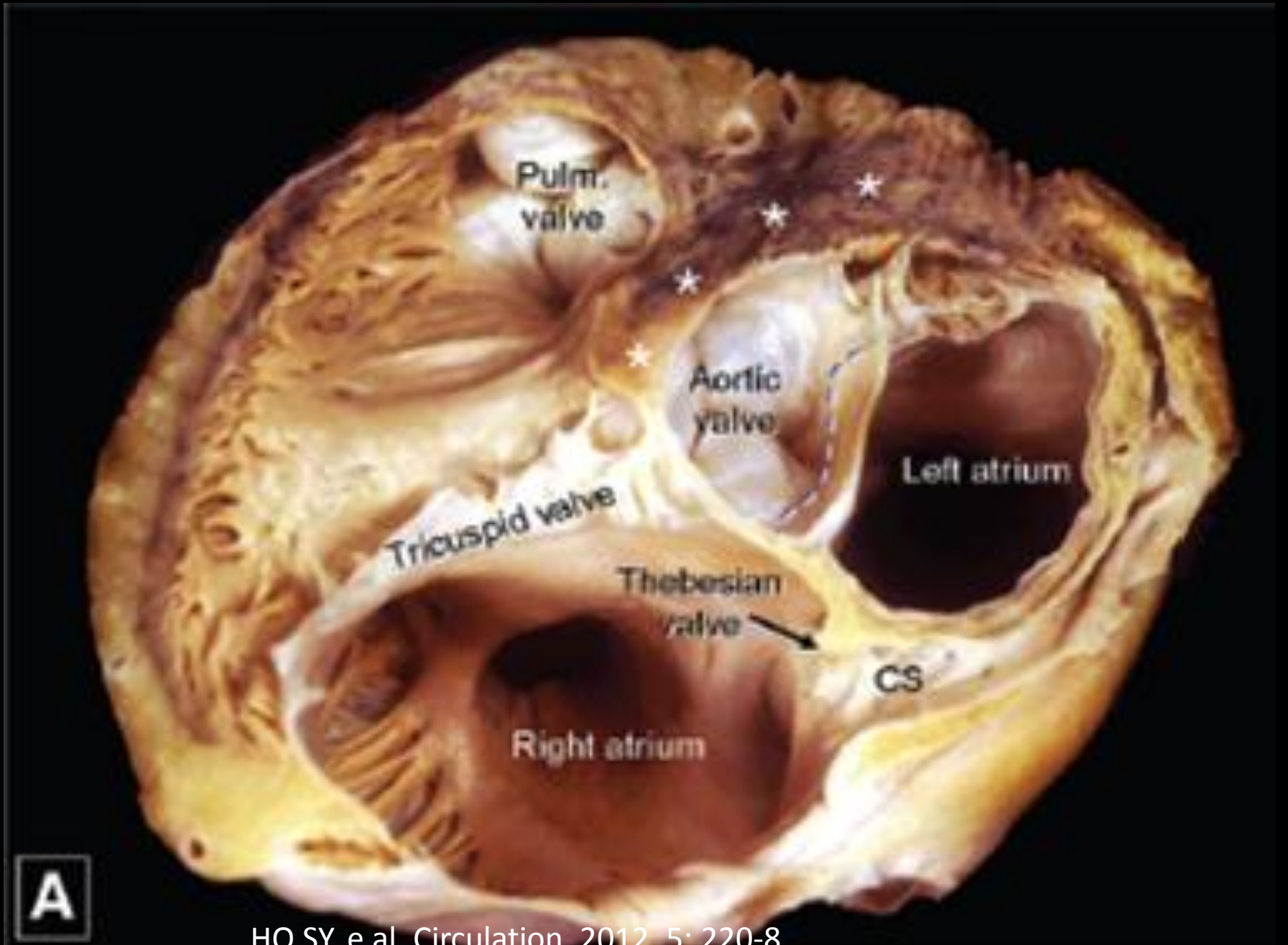
Sol Atriyum Segmenter Morfoloji

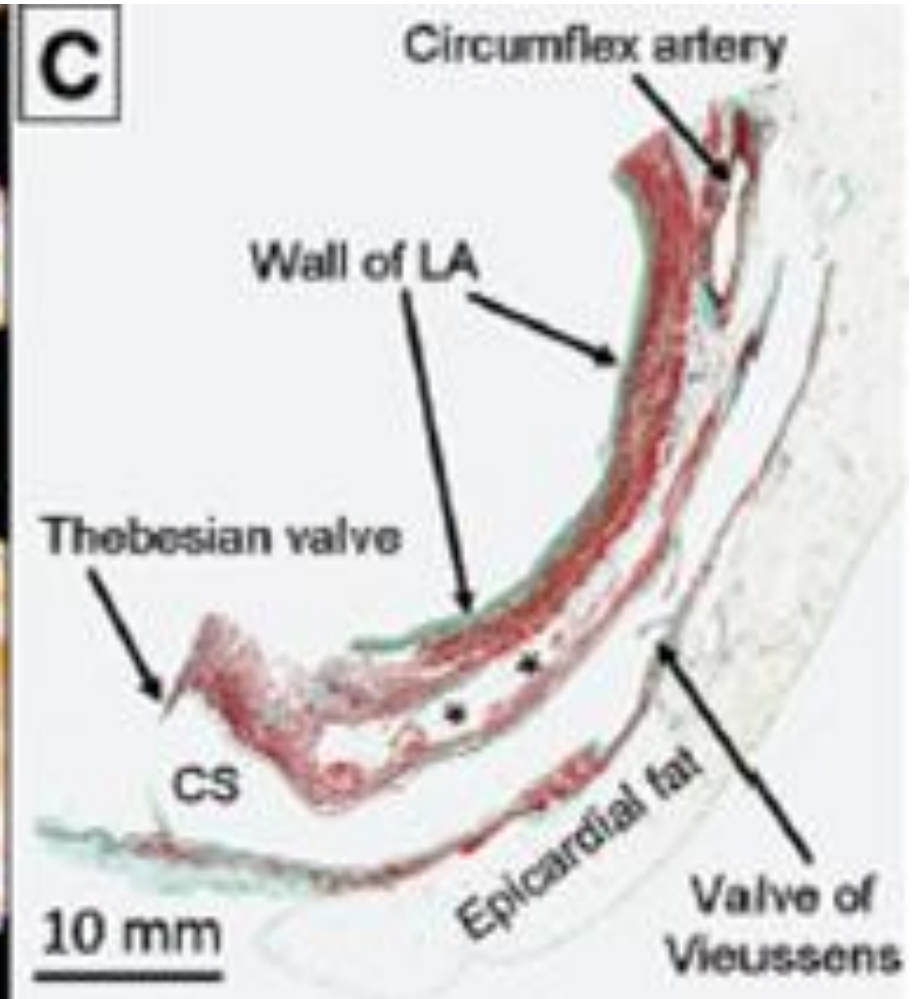
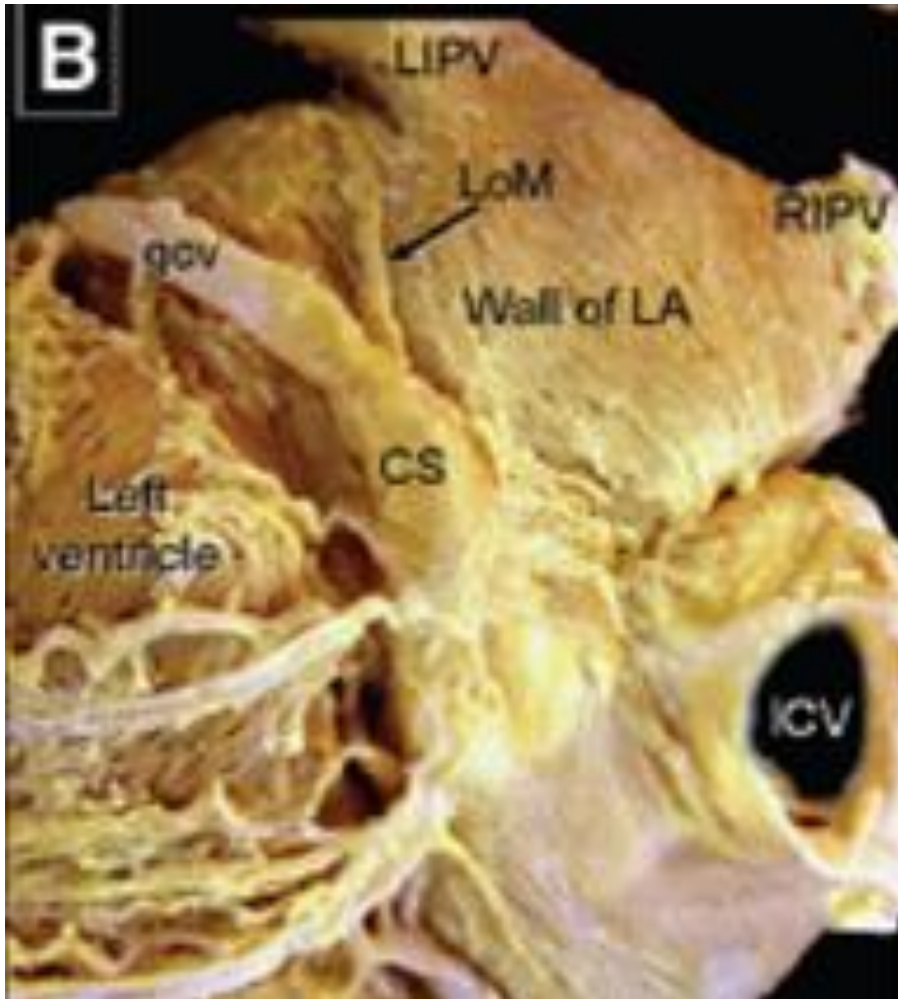






HO SY, e al. Circulation 2012, 5: 220-8.

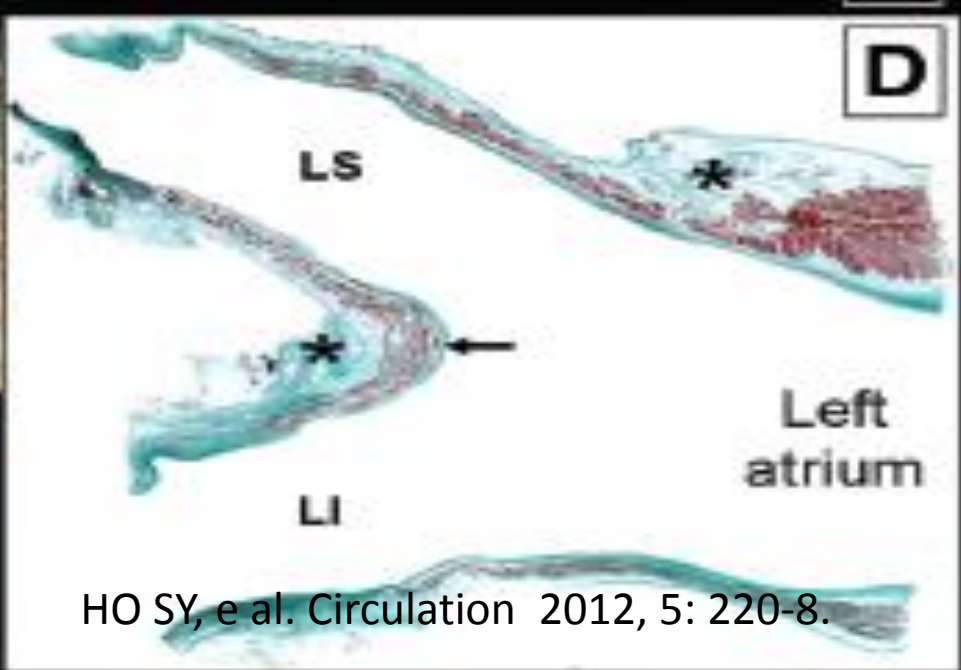
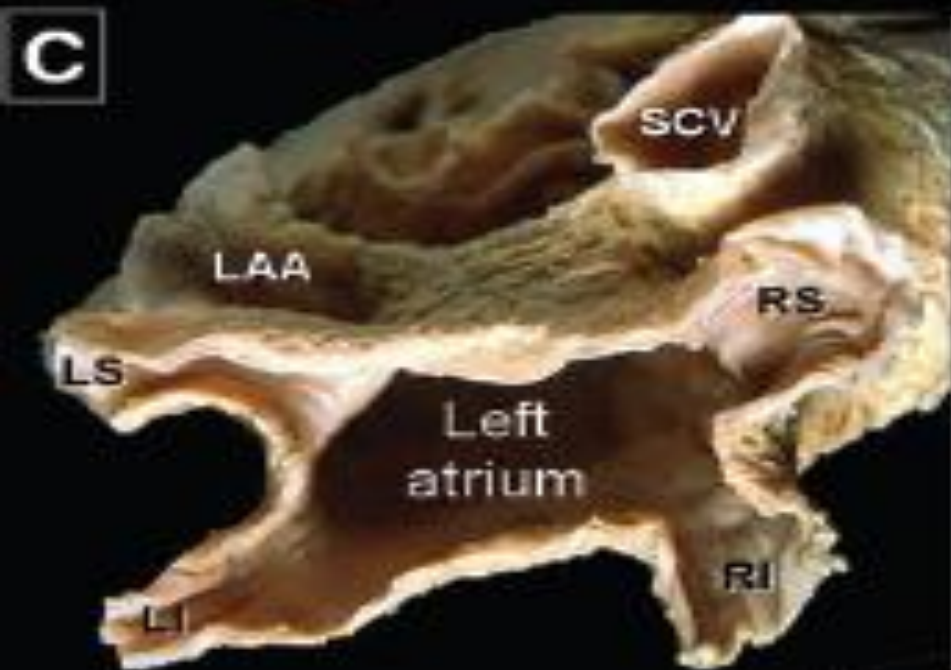
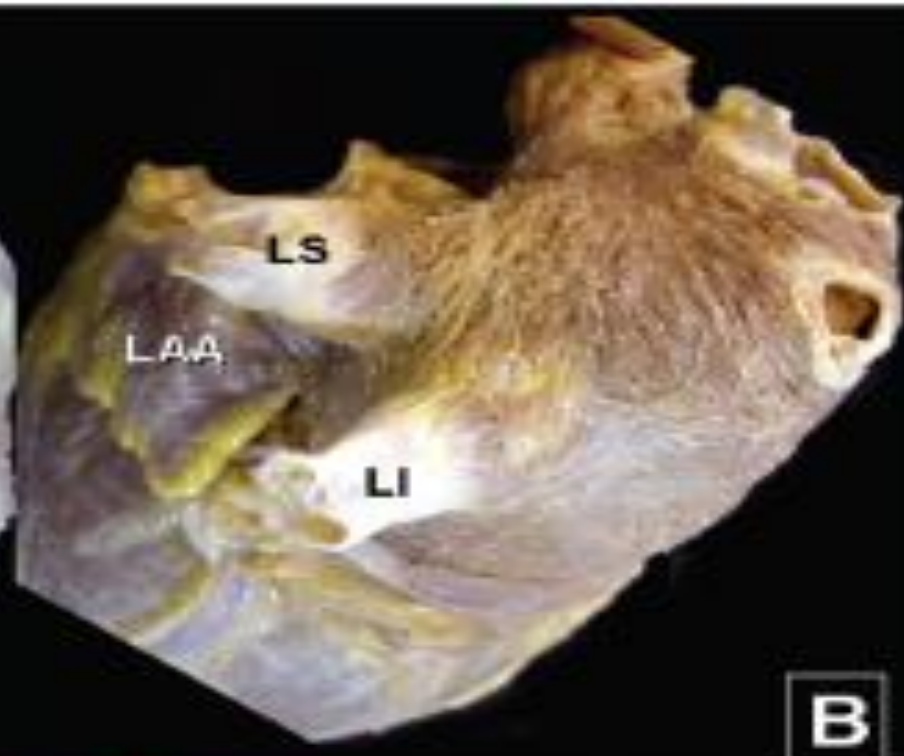
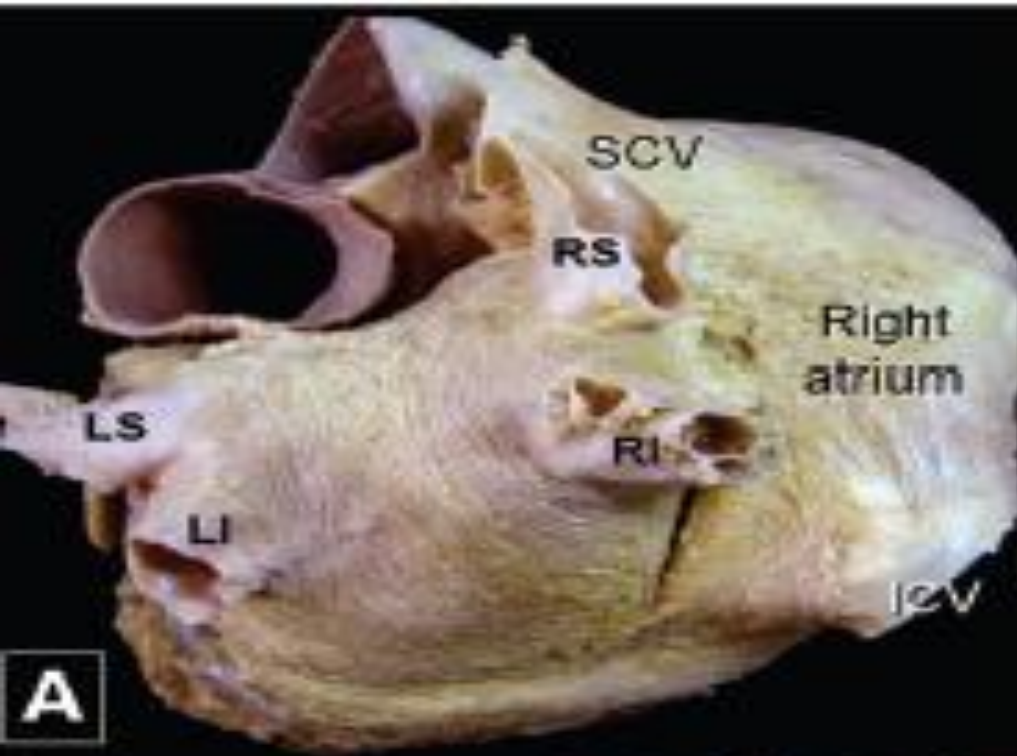


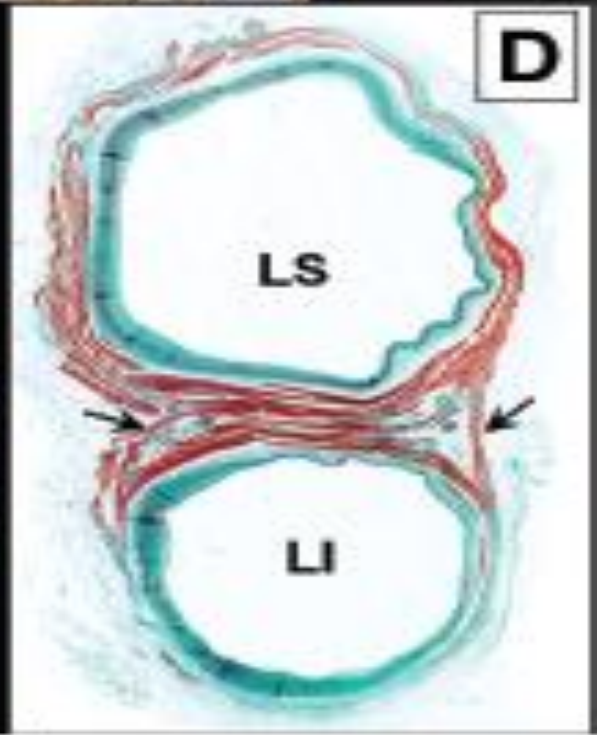
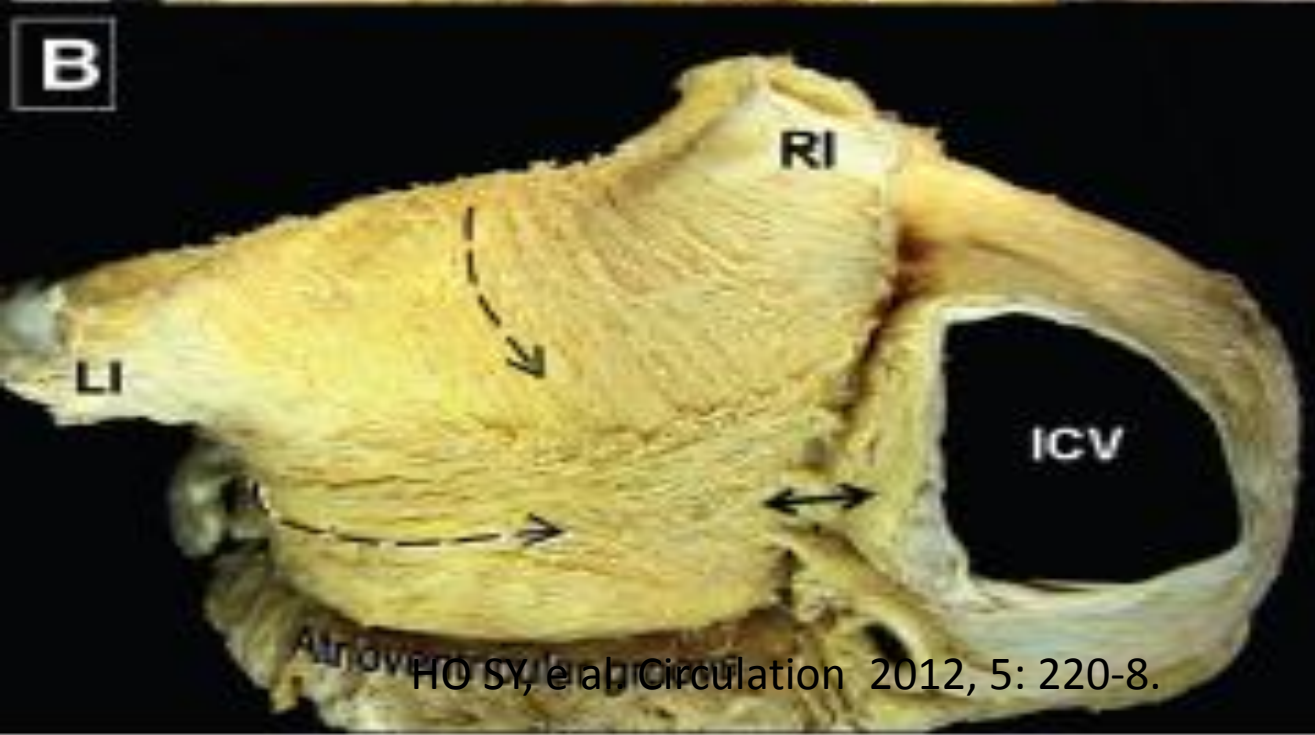
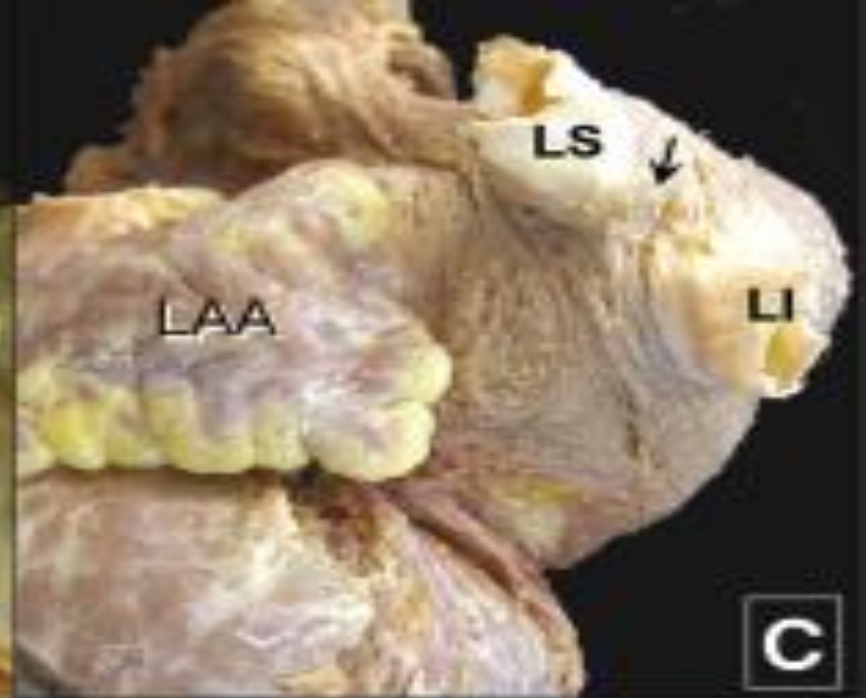
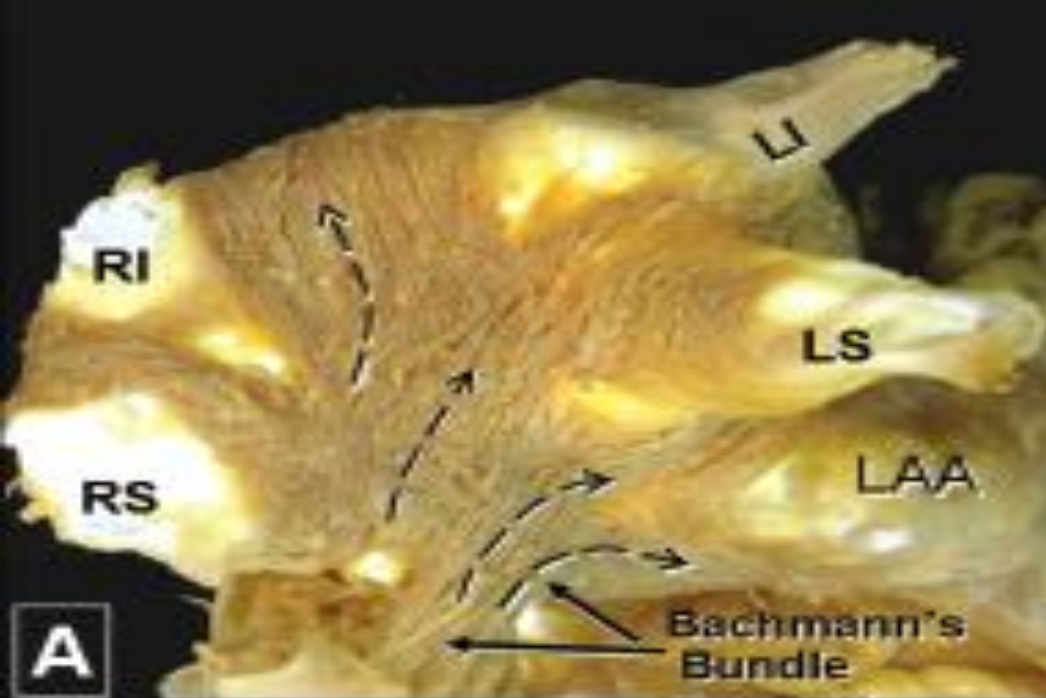


HO SY, e al. Circulation 2012, 5: 220-8.

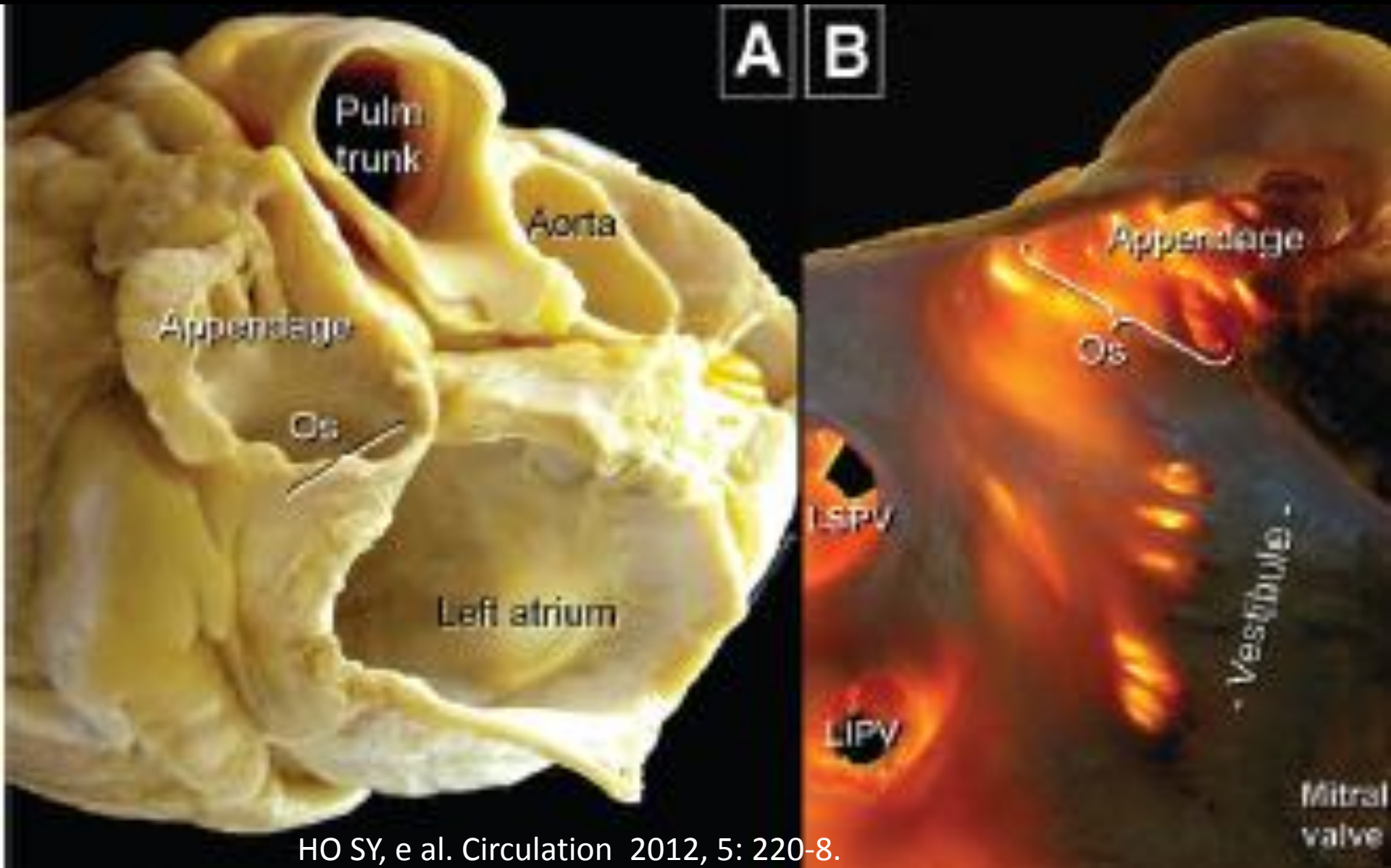


HO SY, e al. *Circulation* 2012, 5: 220-8.

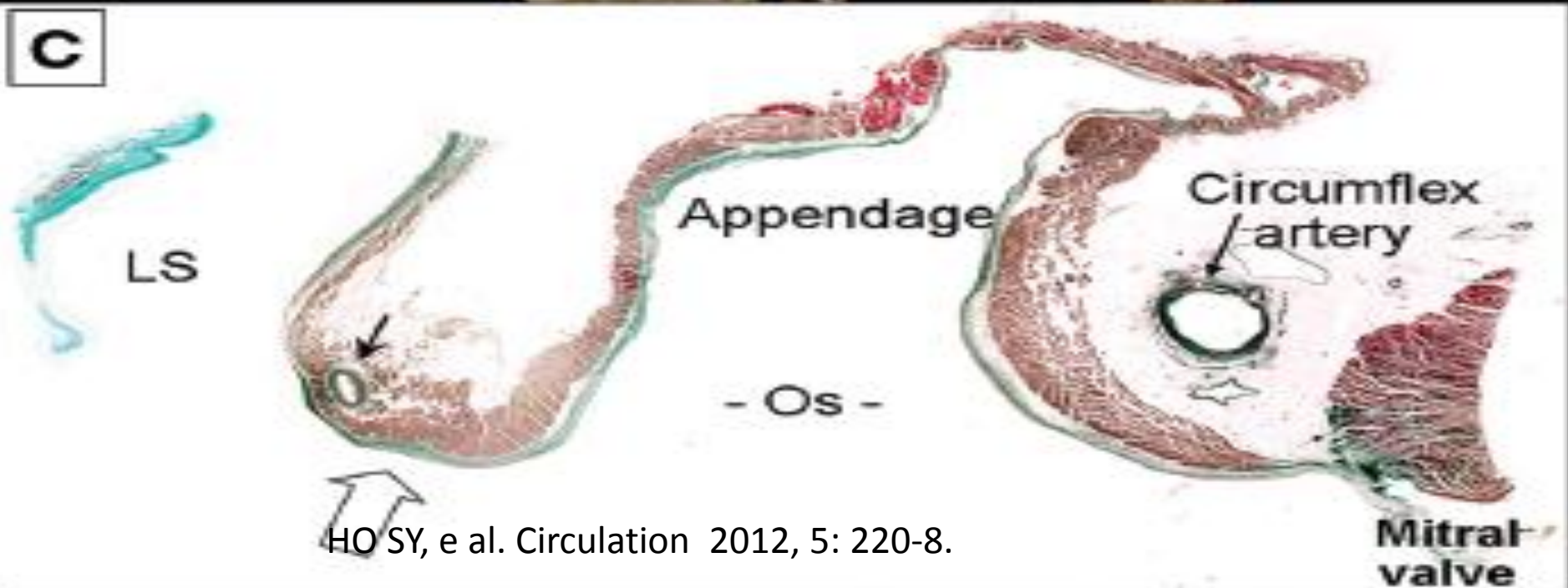
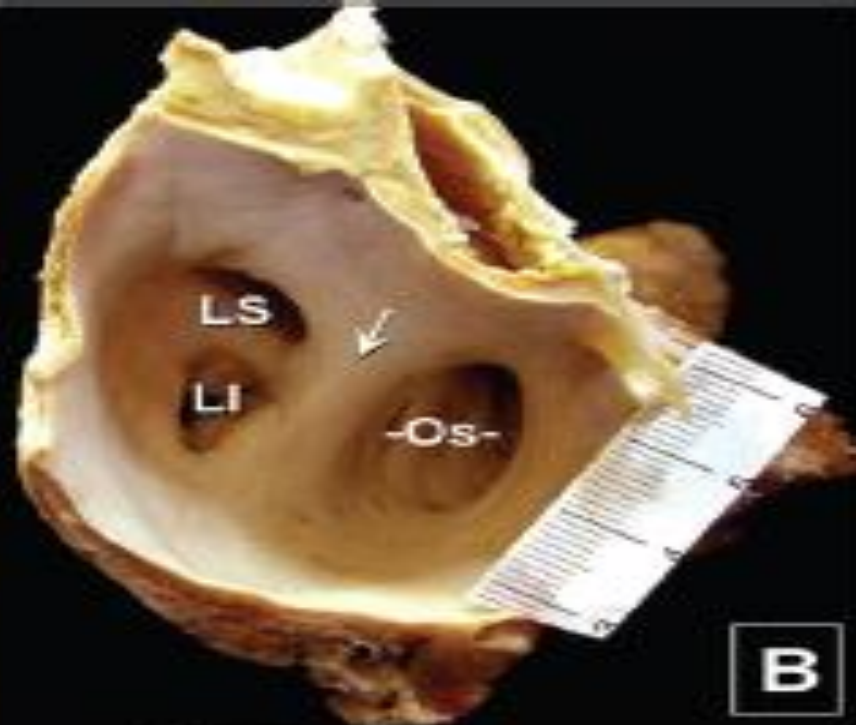




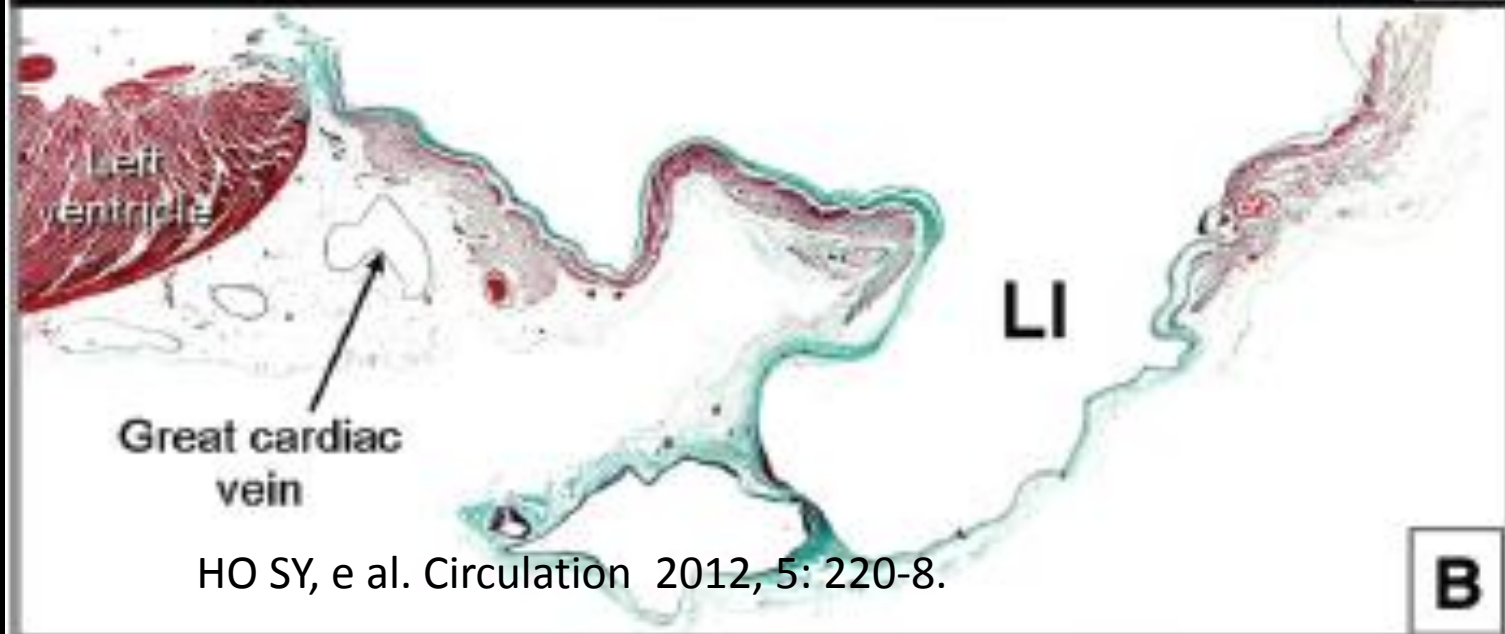
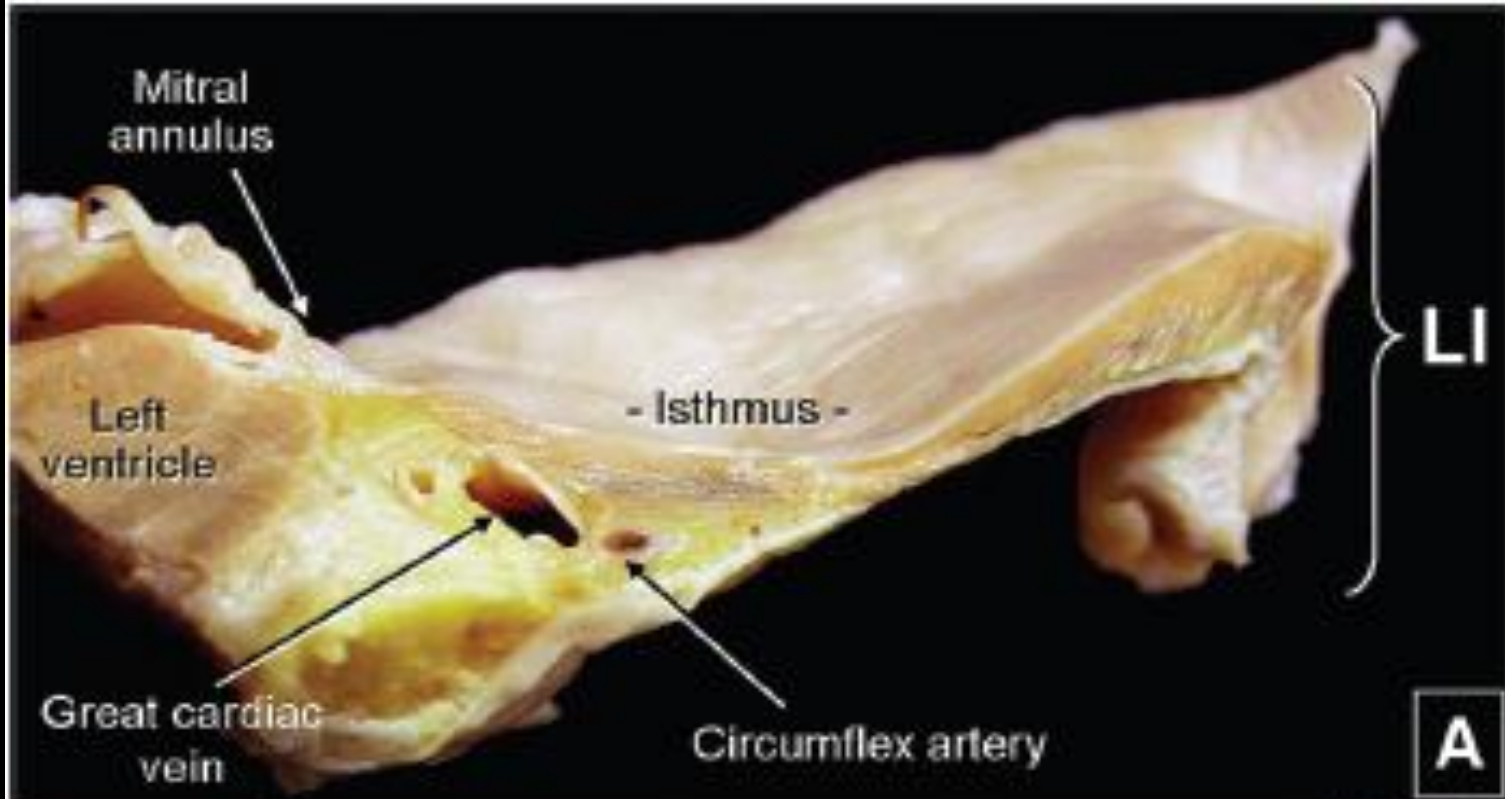
LA appendiks



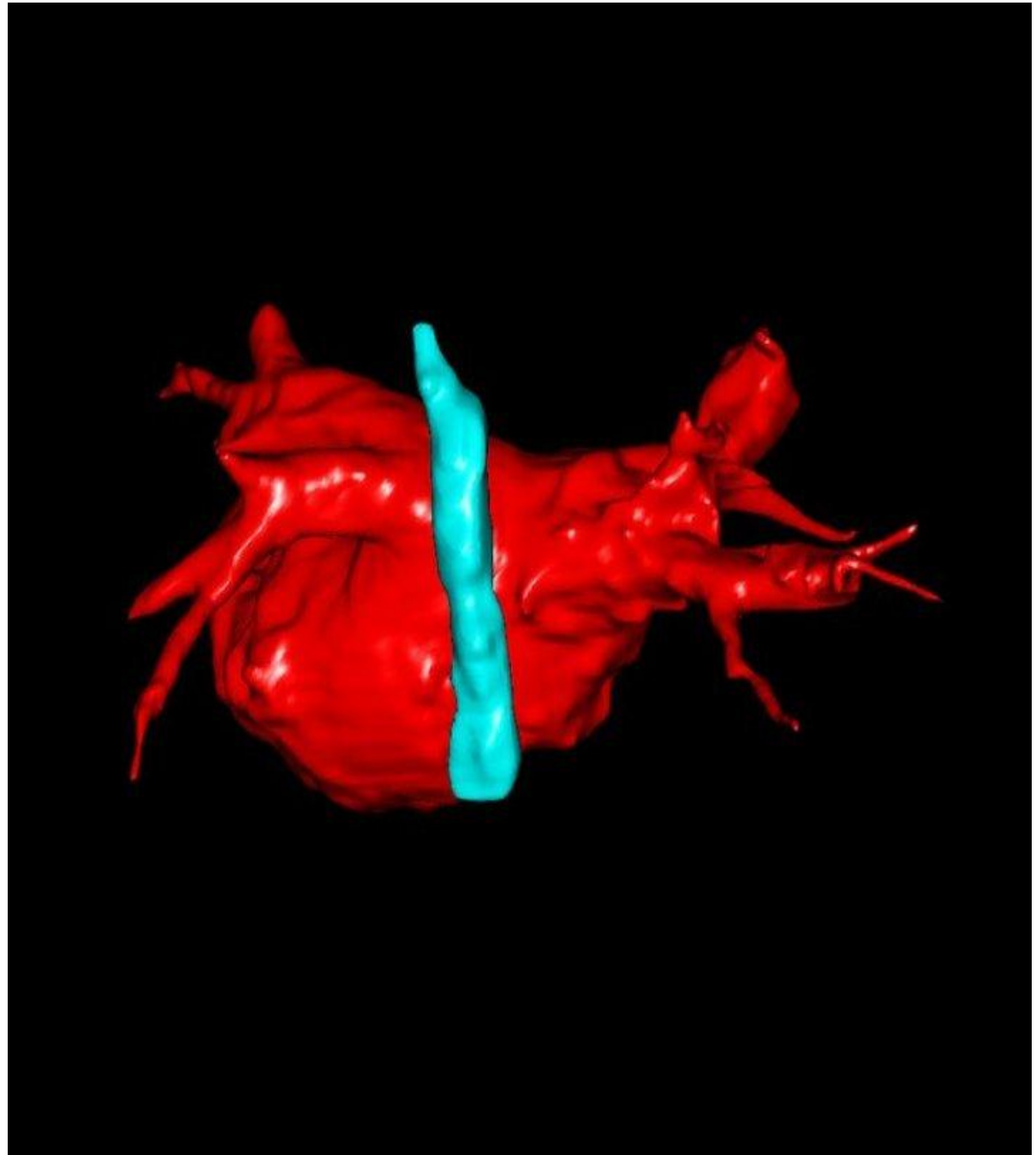
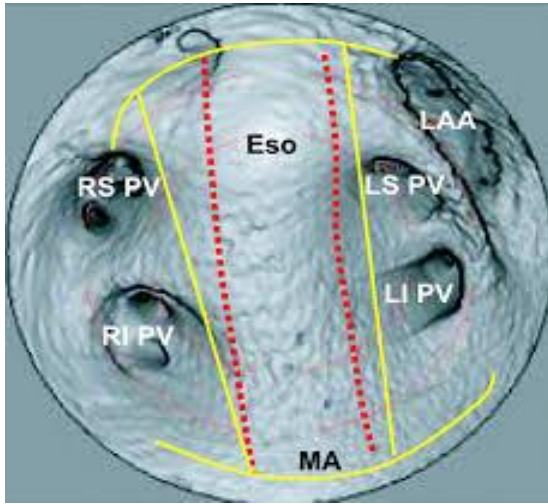
HO SY, e al. Circulation 2012, 5: 220-8.



HO SY, e al. Circulation 2012, 5: 220-8.



HO SY, e al. Circulation 2012, 5: 220-8.







72

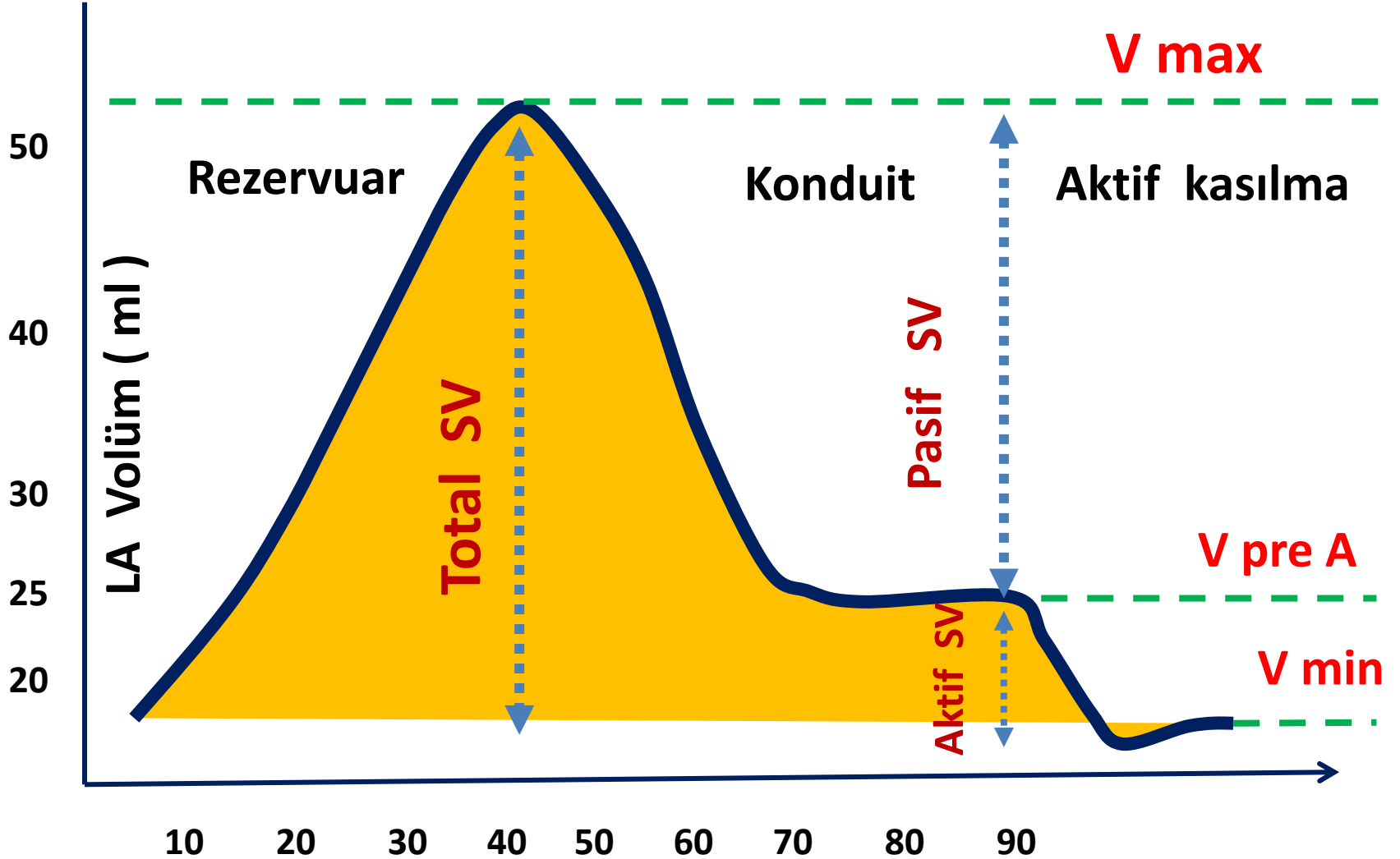
0.1

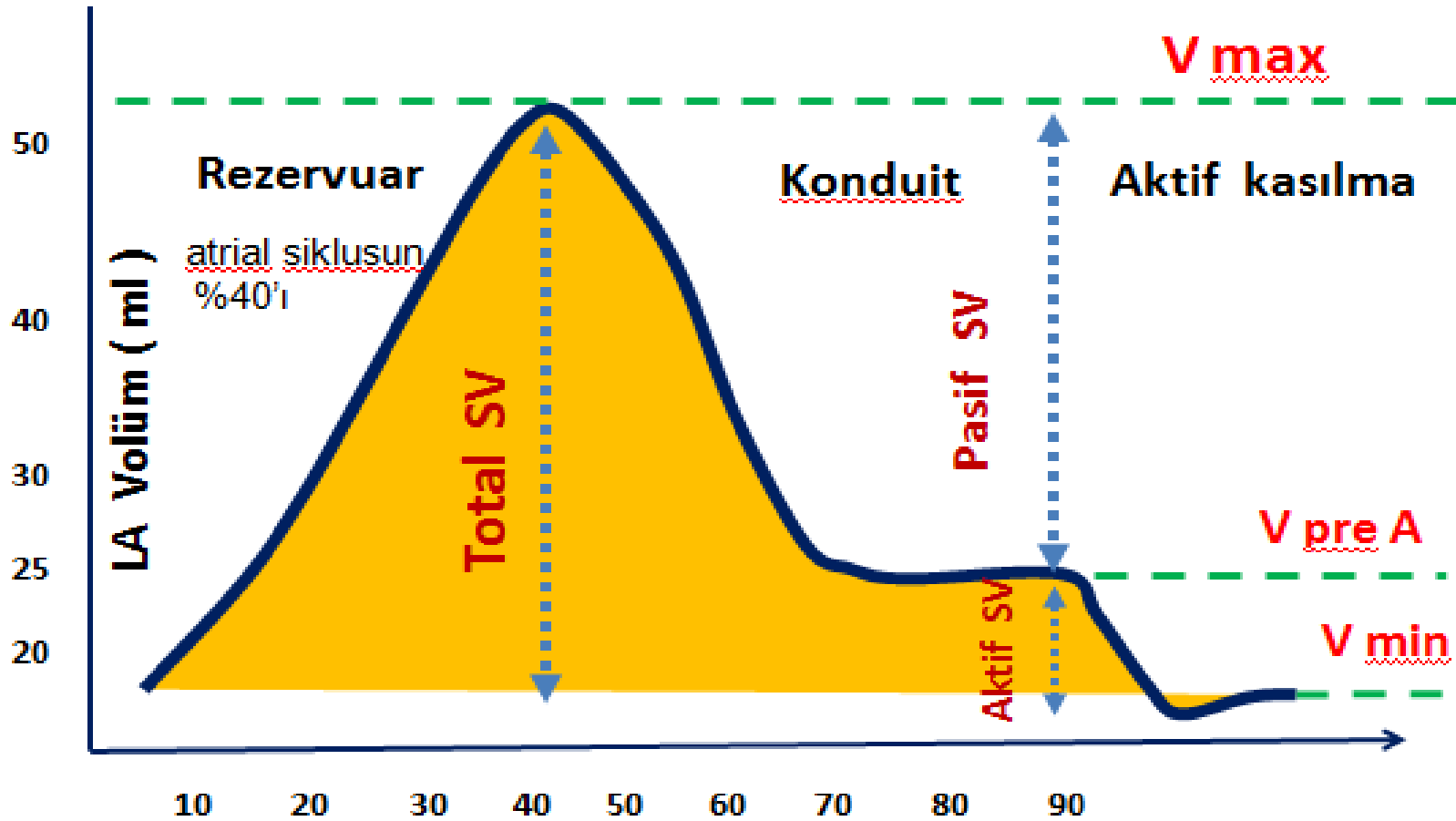


72

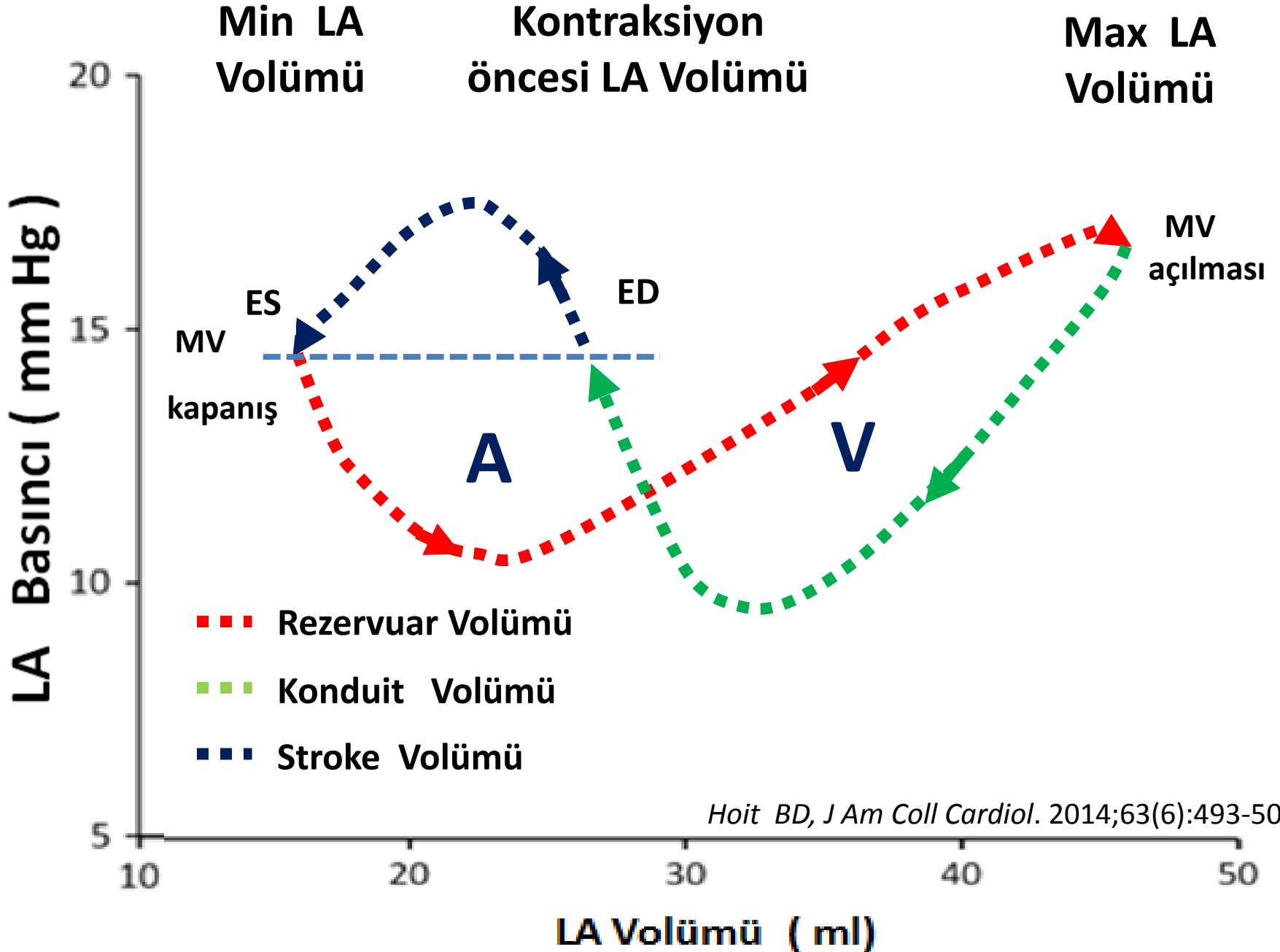
0.1

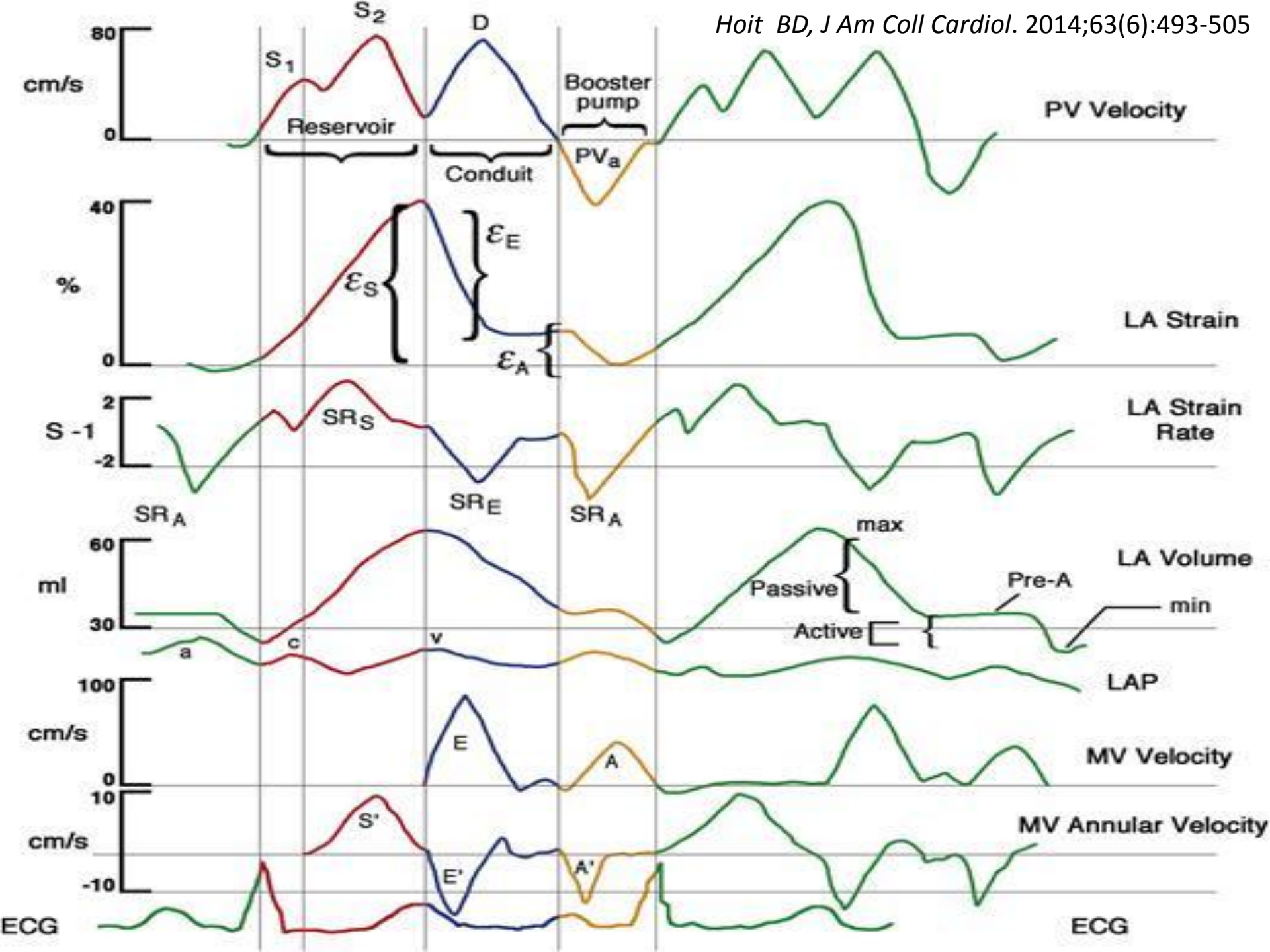
Sol Atriyum Volüm Eğrisi



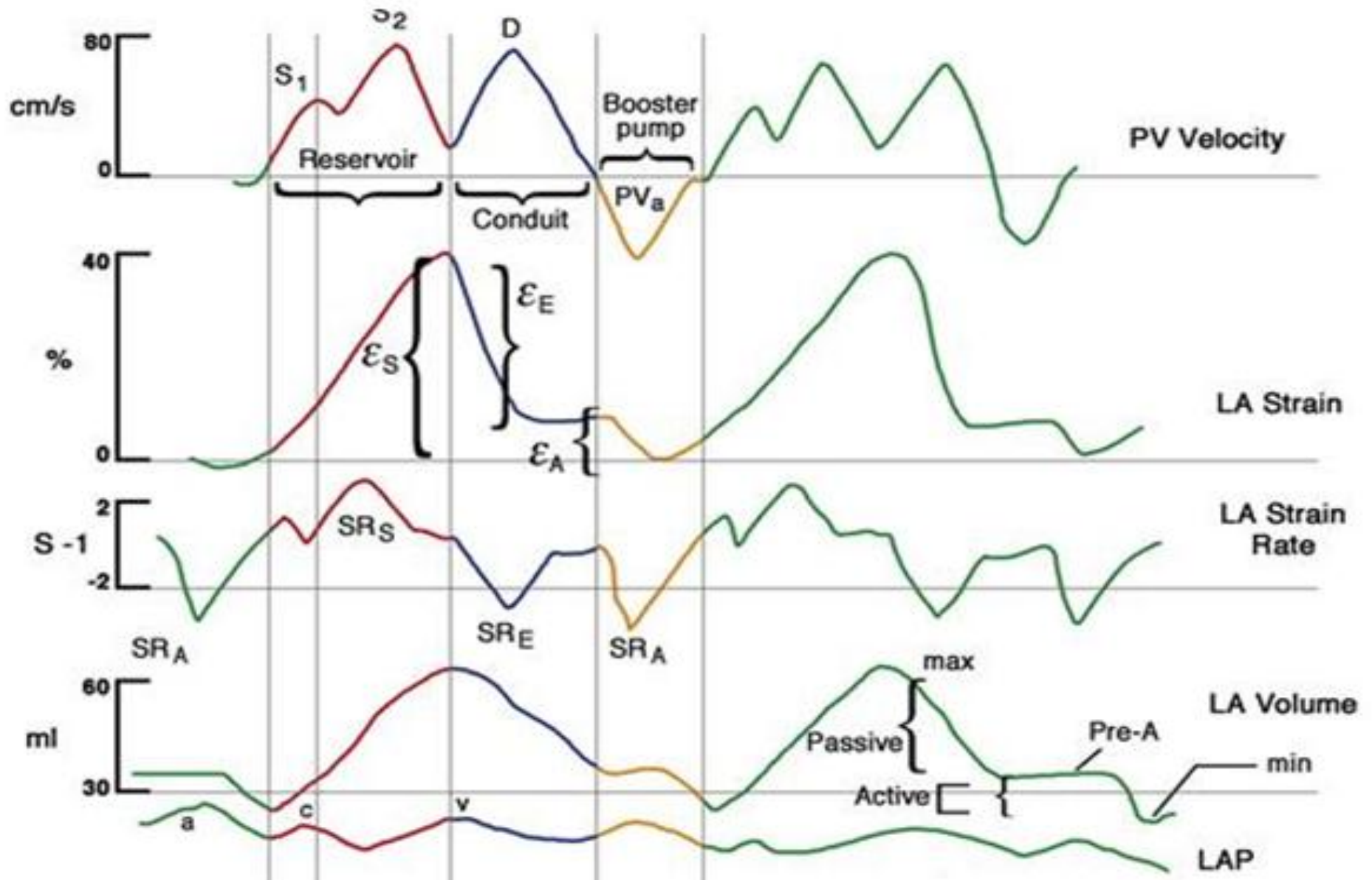


- **LA pasif boşalma volümü** = $V_{max} - V_{preA}$,
- **LA pasif boşalma fraksiyonu** = $[(V_{max} - V_{preA}) / V_{max}] \times 100\%$,
- **LA aktif boşalma volümü** = $V_{preA} - V_{min}$,
- **LA aktif boşalma fraksiyonu** = $[(V_{preA} - V_{min}) / V_{preA}] \times 100\%$.

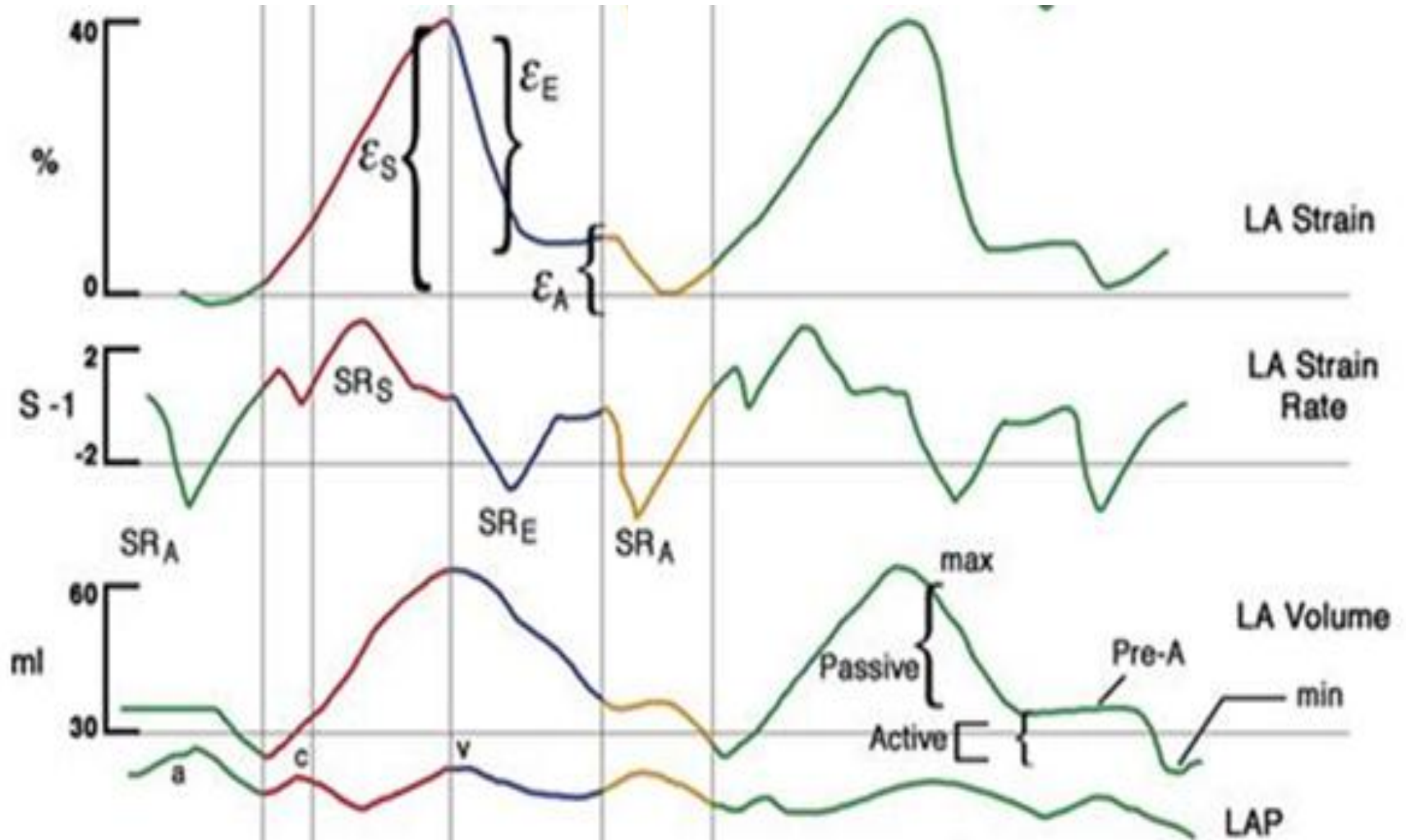




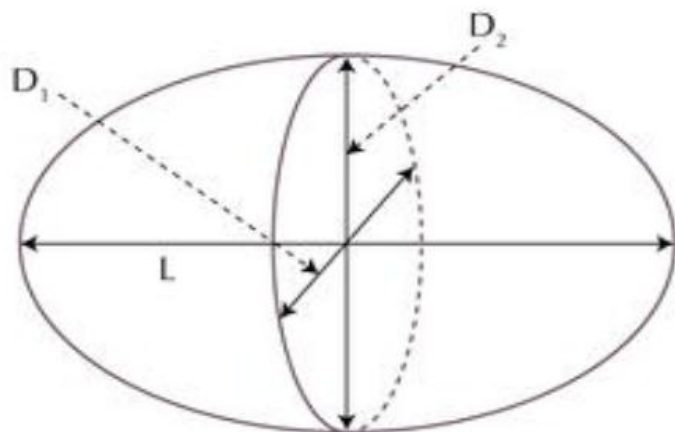
PV akımları, LA Strain, SR, Volüm ve Basınç



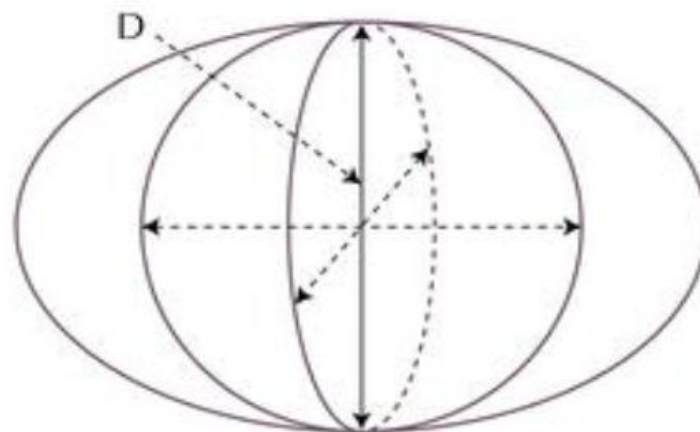
LA Strain, Strain Rate, Volüm ve Basınç



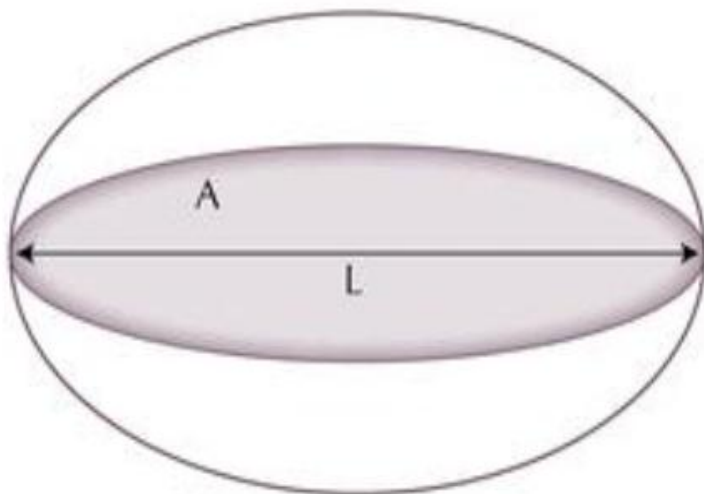




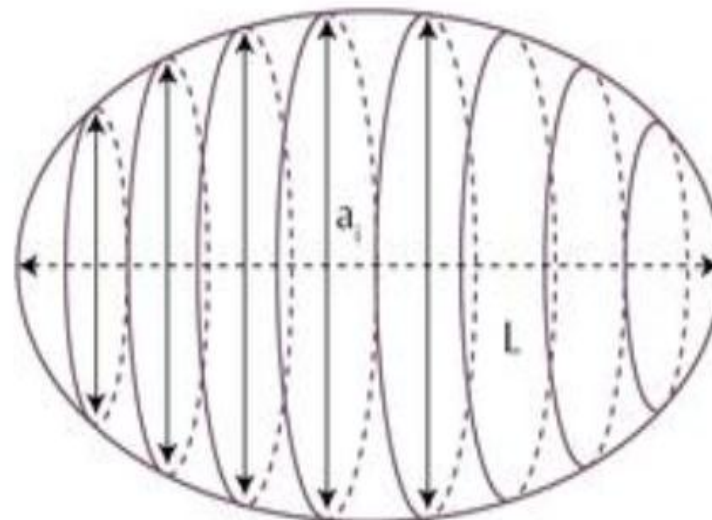
Ellipsoid: Dimension–Length
 $V = 4/3\pi(D_1/2)(D_2/2)(L/2)$



Cube
 $V = 4/3\pi(D/2)^3$

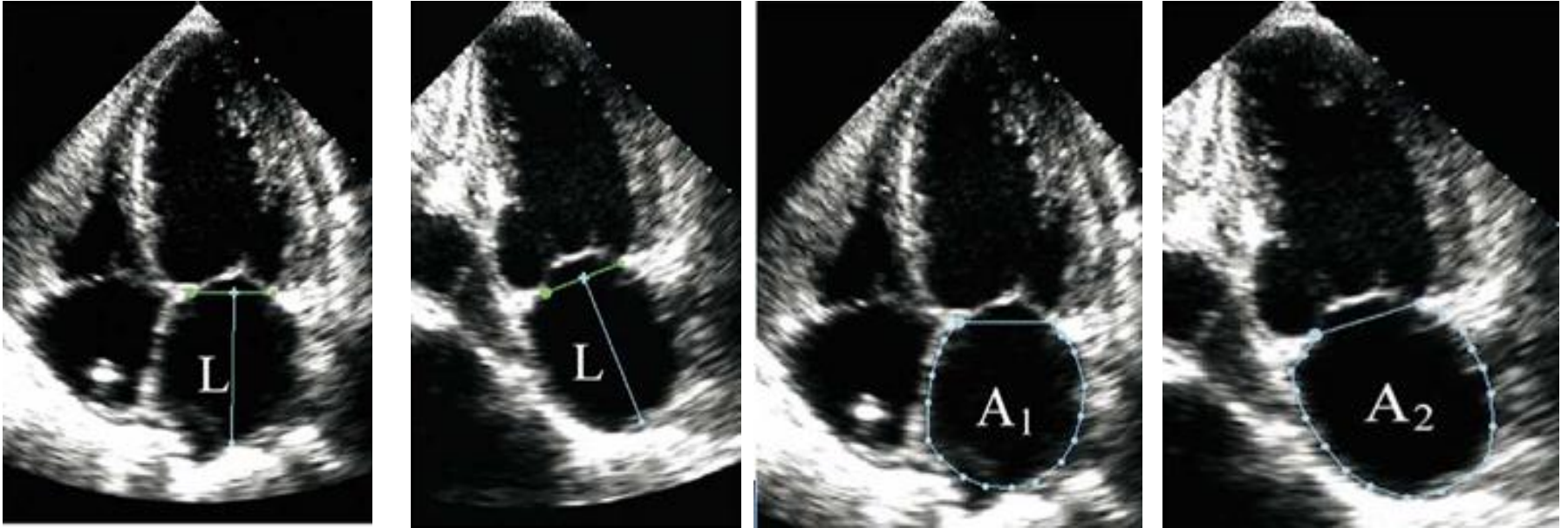


Ellipsoid: Area–Length
 $V = 8A^2/3\pi L$



Method of discs
 $V = \pi/4 * \sum(a_i)^2(L/n)$

Biplan Area-Length Yöntemi LA Volüm Ölçümü

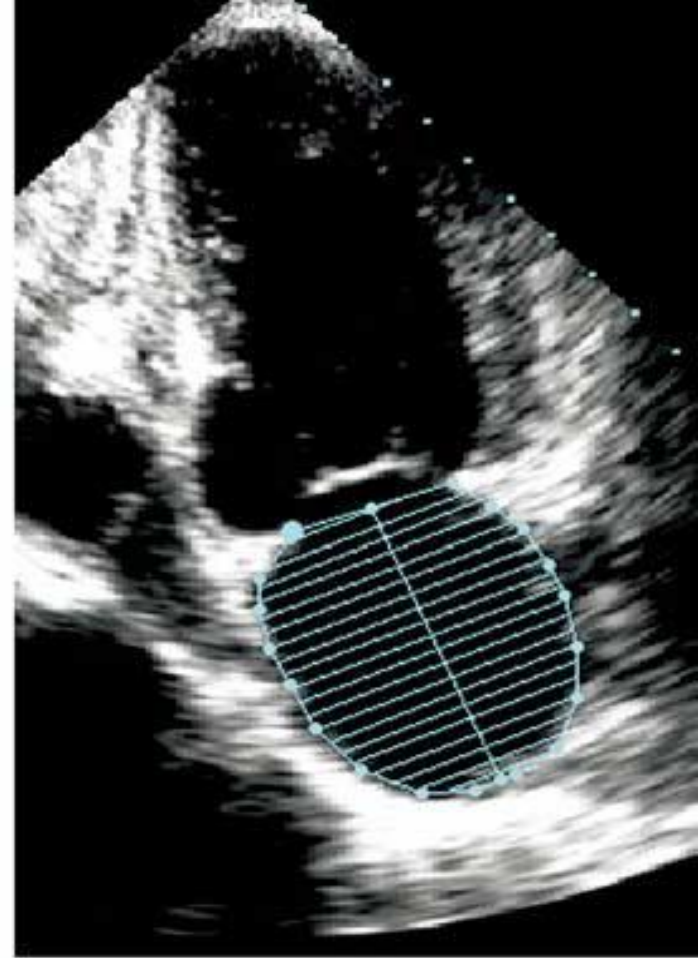


$$\text{LA Volüm} = \frac{8}{3}\pi \left[\frac{(A_1)(A_2)}{(L)} \right]^*$$

Modifiye Simpson Yöntemi



A4C



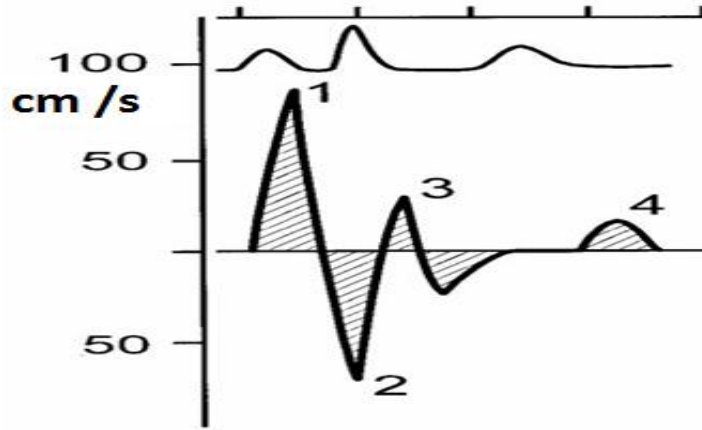
A2C

LA Volum İndeksi (ml /m²)

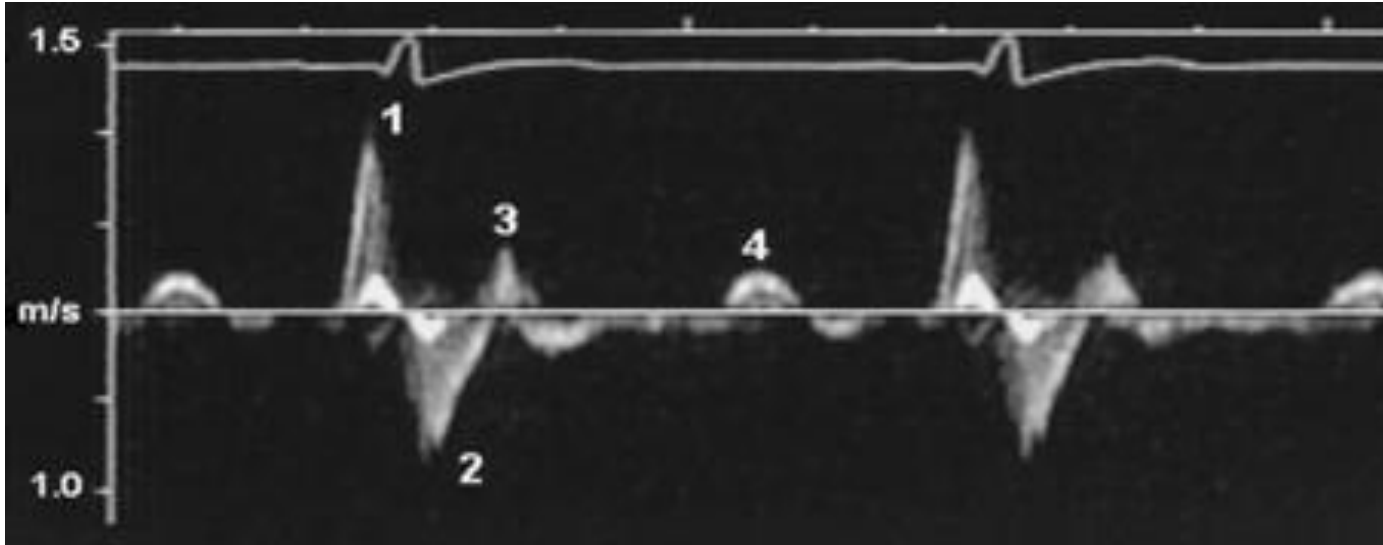
| Normal | Hafif | Orta | İleri |
|--|-------------------------------|-------------------------------|----------------------------|
| 22 ₋ +6 ml /m ² | 29 – 33 ml /m ² | 34 – 39 ml /m ² | > 40 ml /m ² |

Sol Atriyal Appendiks Akım Hızları

Agmon Y, et al. Am J Cardiol 2000;86: 769-73.

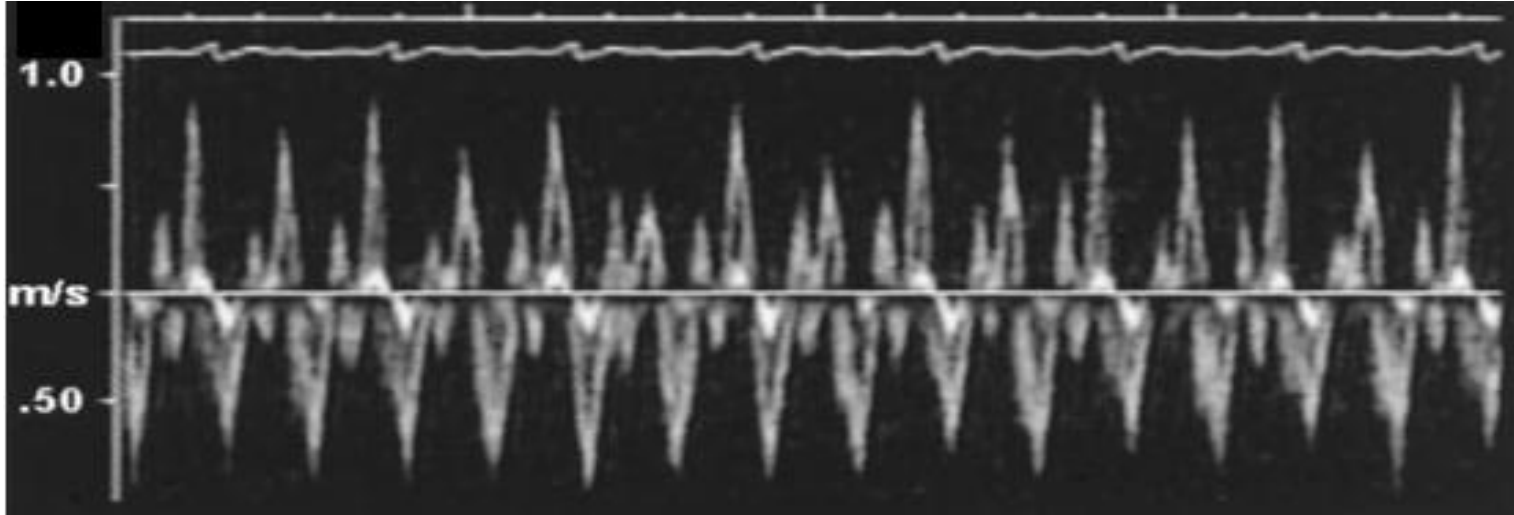


1. LAA kasılması,
2. LAA doluşu,
3. Sistolik yansıma dalgaları
4. Erken diyastolik LAA çıkış akımı

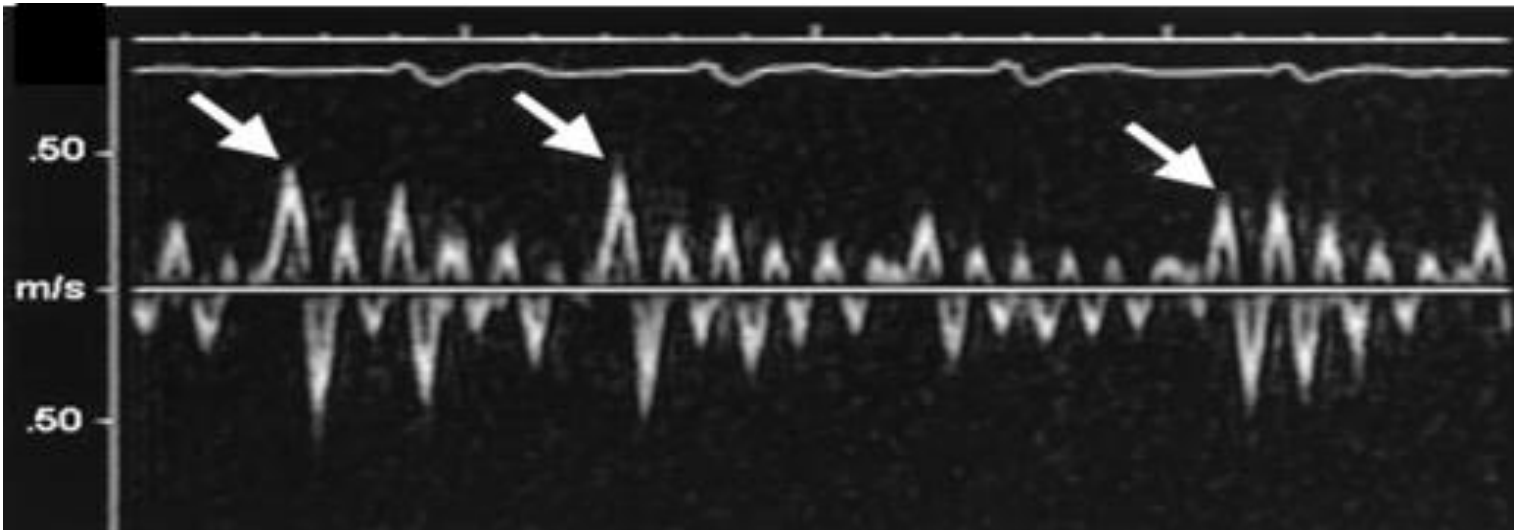


1 ve 2 her 10 yılda bir 4.1 cm/s ($p < 0.001$) ve 2.0 cm/s ($p < 0.01$) azalıyor.

AF ve A. Flutterde LAA Akımları



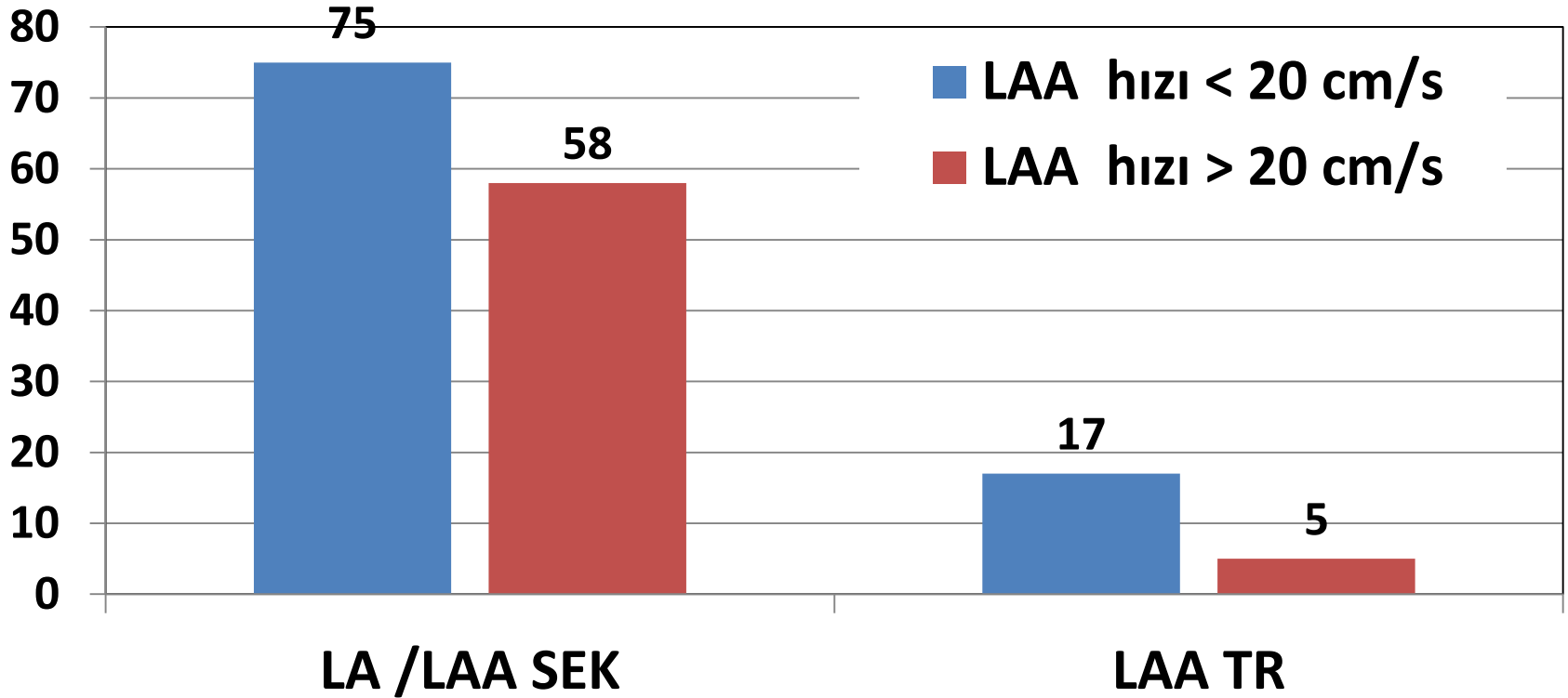
Atriyal Flutter



Atriyal Fibrilasyon

SPAF III

LAA Akım Hızları ve SEK / TR



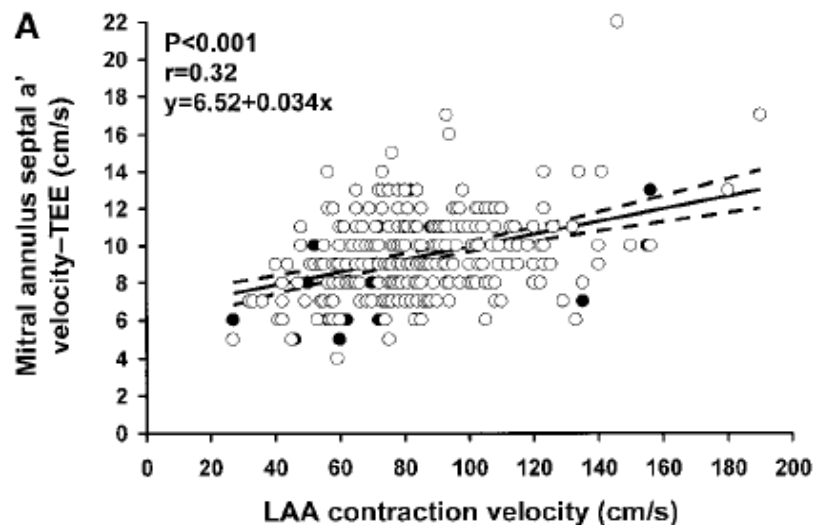
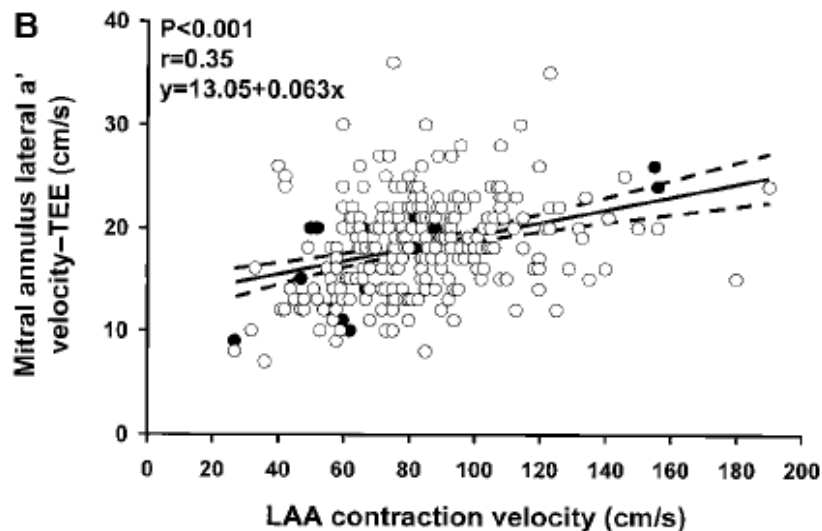
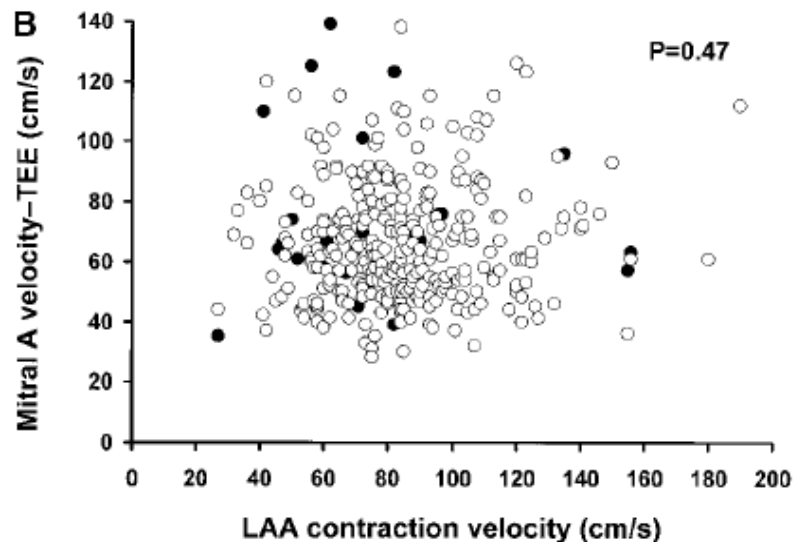
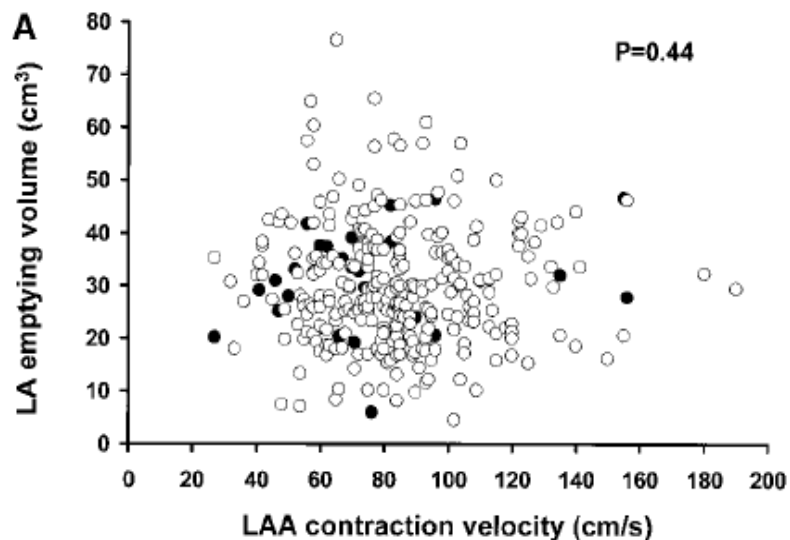
LAA hızı < 20 cm/s ise göreceli iskemik inme riski 2.6 kat artmış.

The Stroke Prevention in Atrial Fibrillation Investigators Committee on Echocardiography.
Ann Intern Med 1998;128:639-47

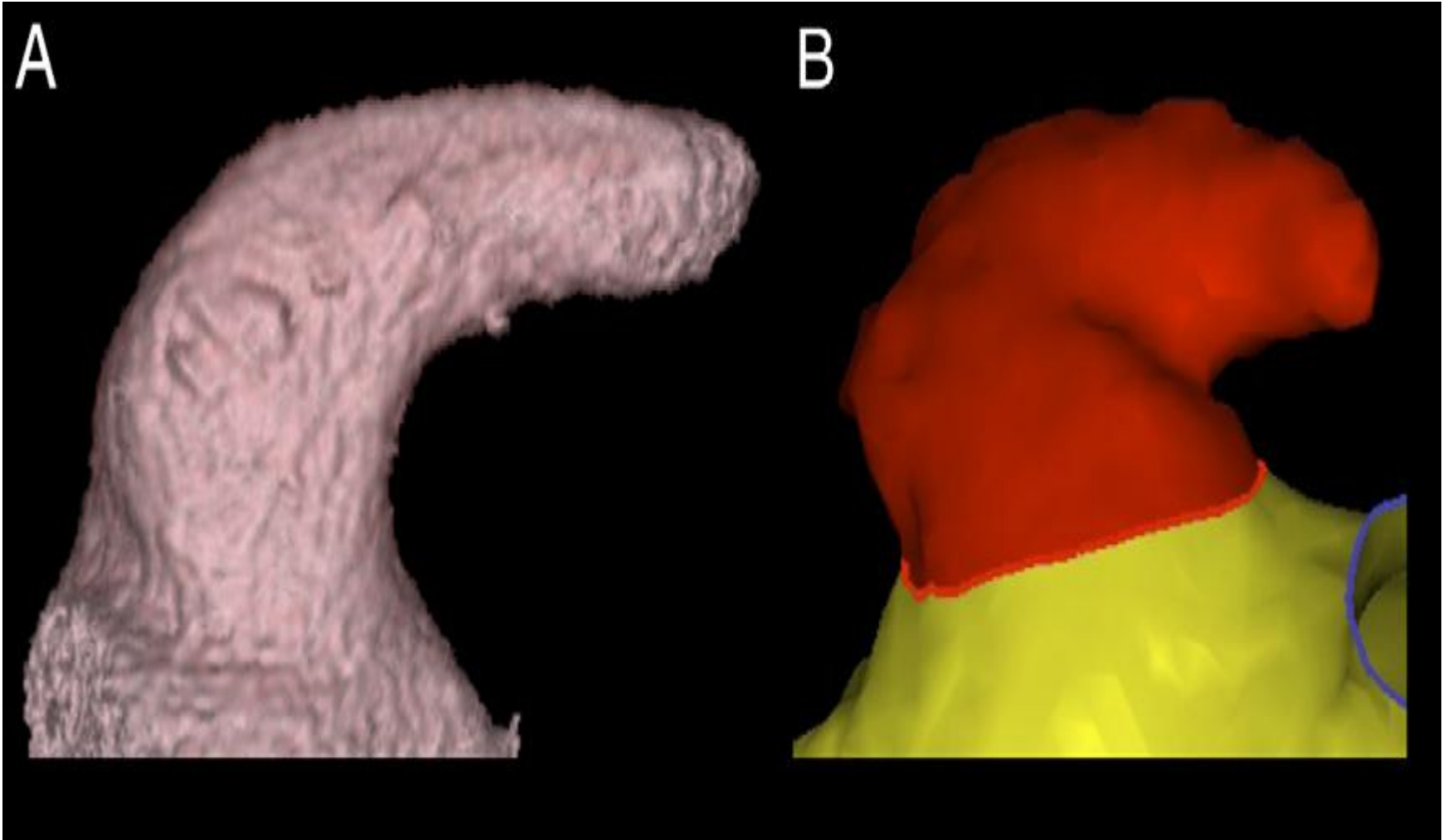
LAA hızları LA Fonksiyonu için kullanılamazlar.

Stroke Prevention: Assessment of Risk in a Community(SPARC)

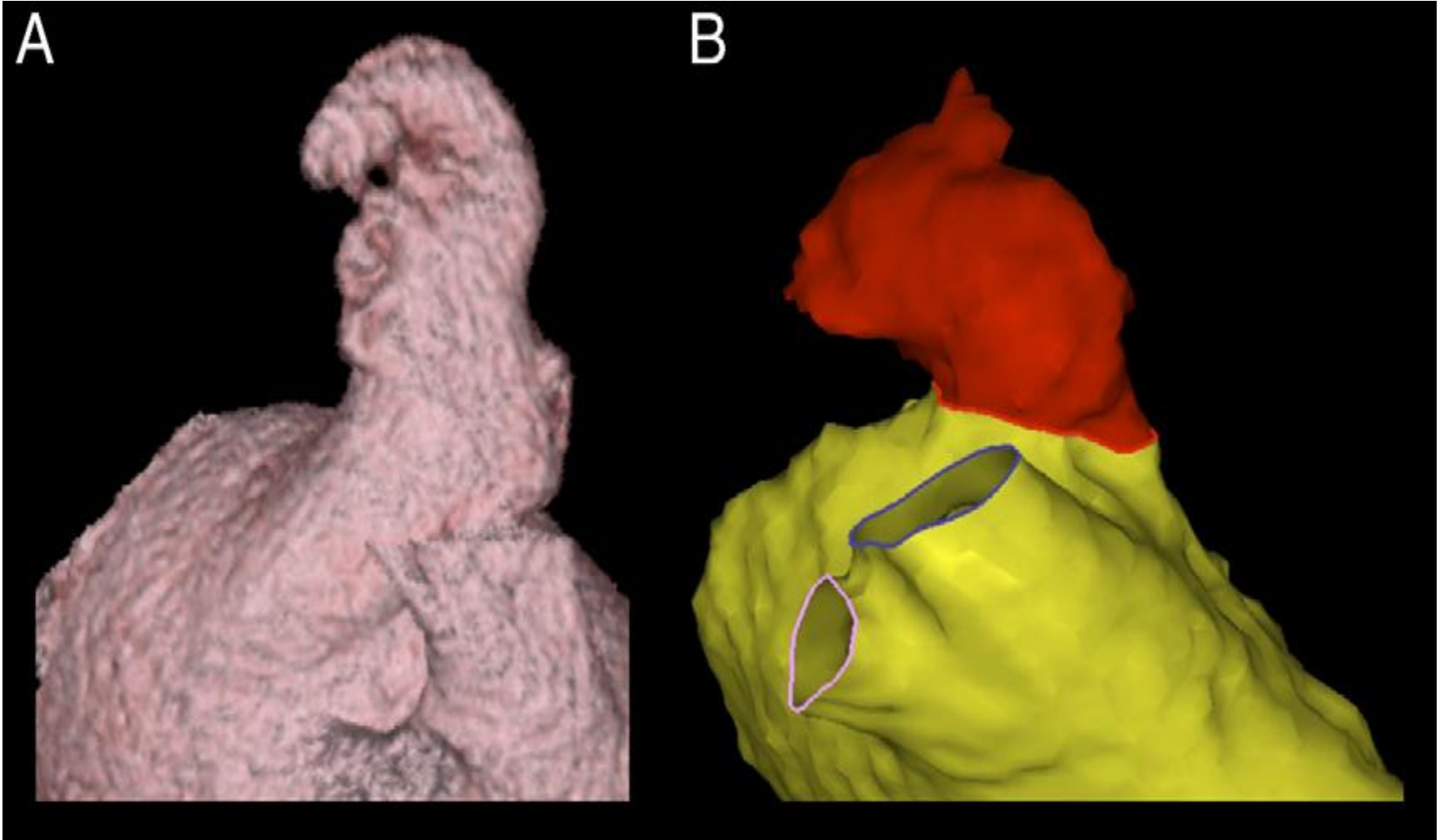
Agmon Y,et al. J Am Soc Echocardiogr 2002;15:433-40



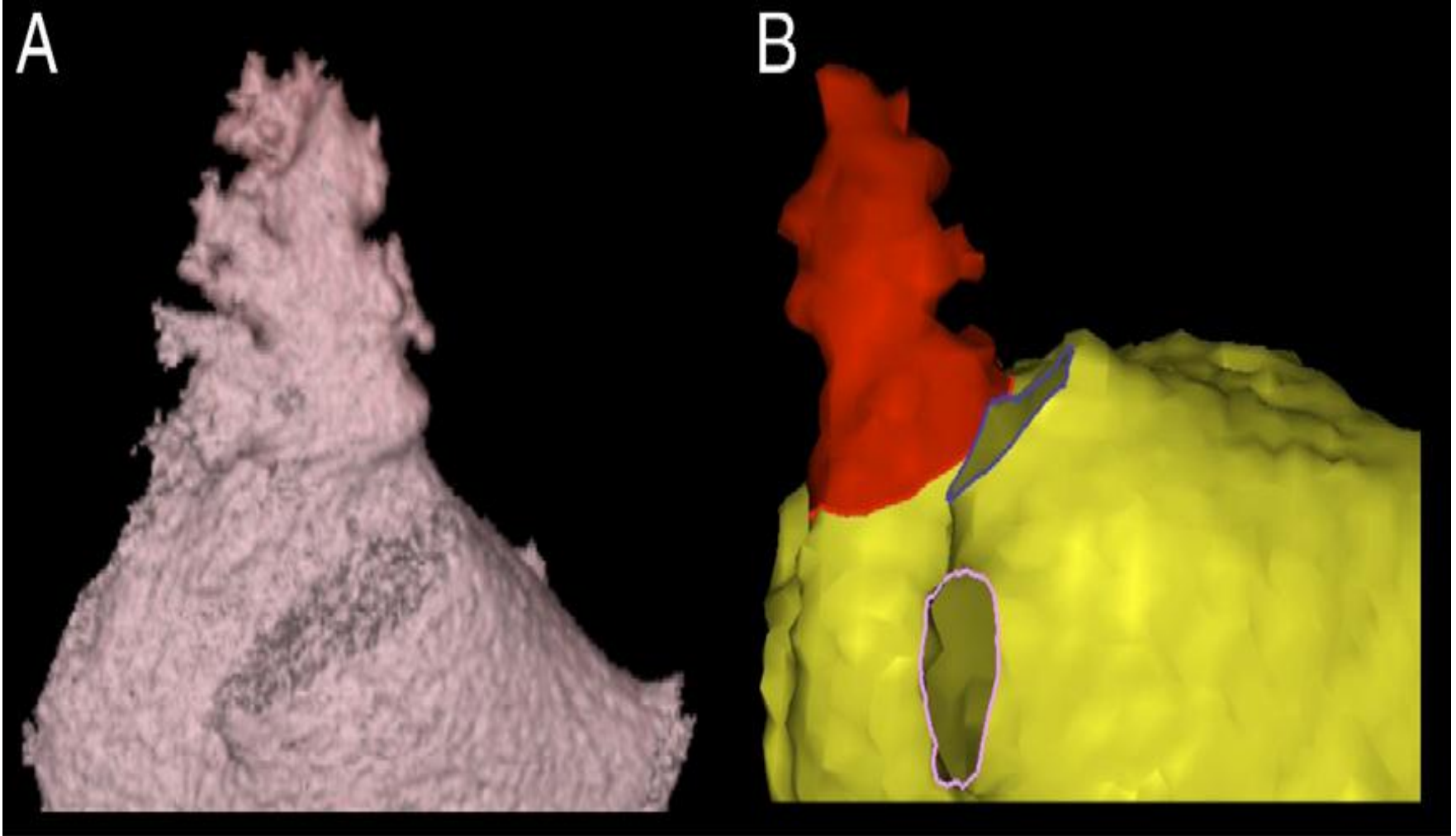
Piliç Kanadı (Chicken Wing) biçimli LAA (% 48)



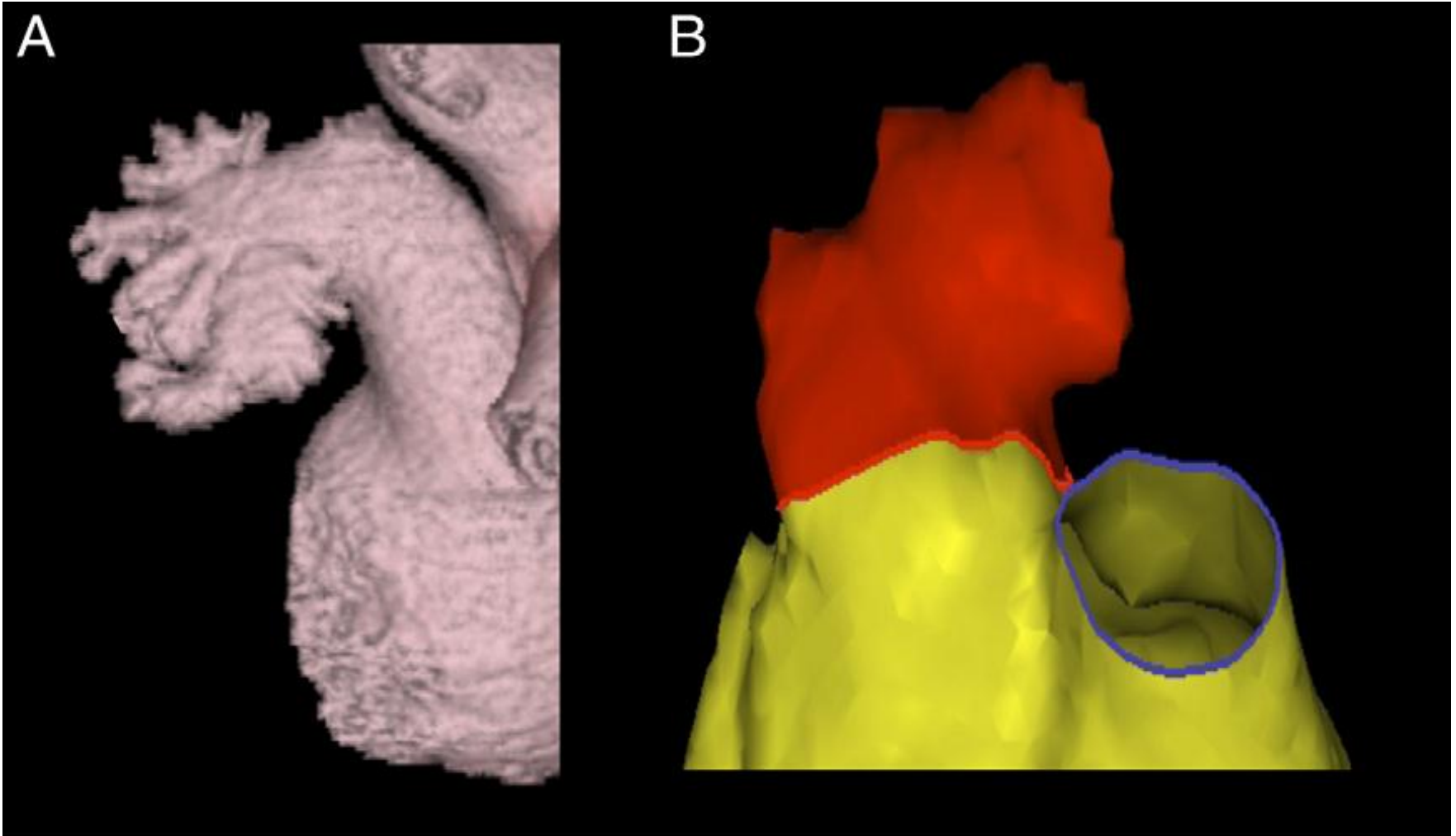
Rüzgar Tulumu (Windsock) biçimli LAA (% 19)



Kaktüs biçimli LAA (% 30)

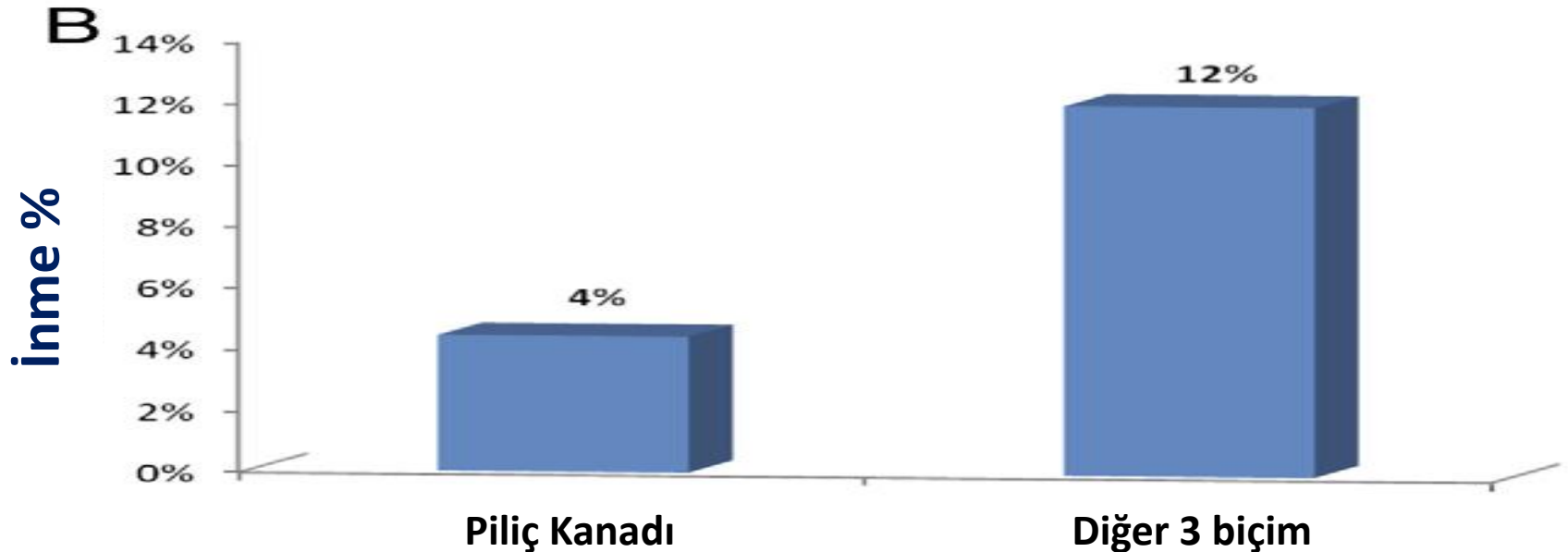
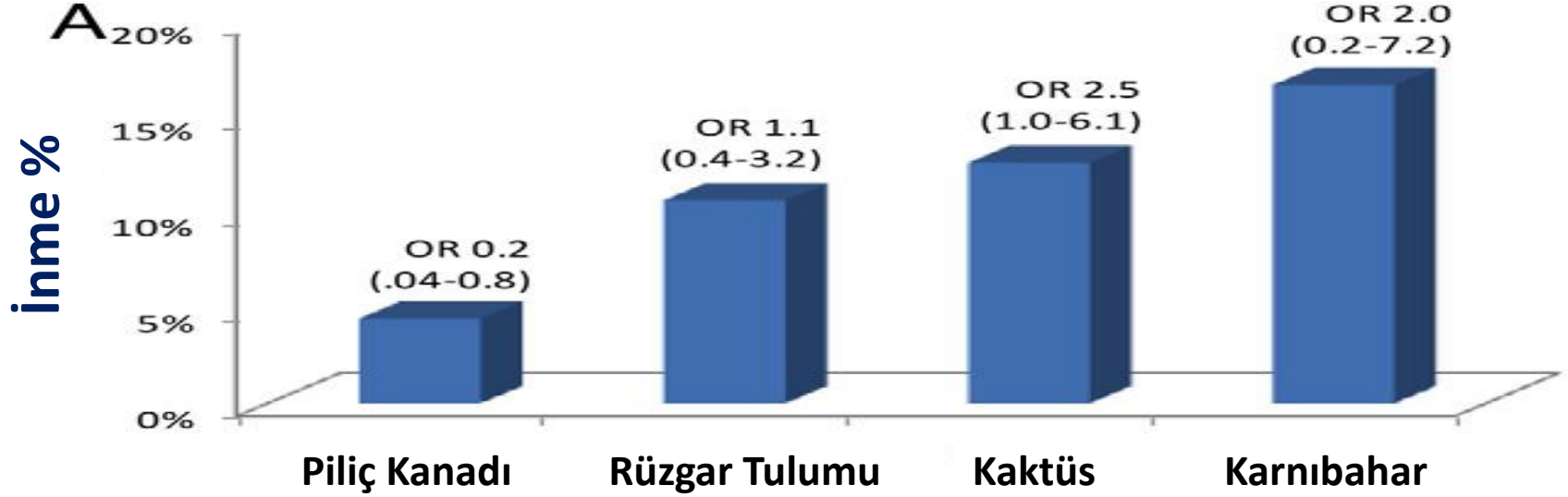


Karnabahar (Cauliflower) biçimli LAA (% 3)

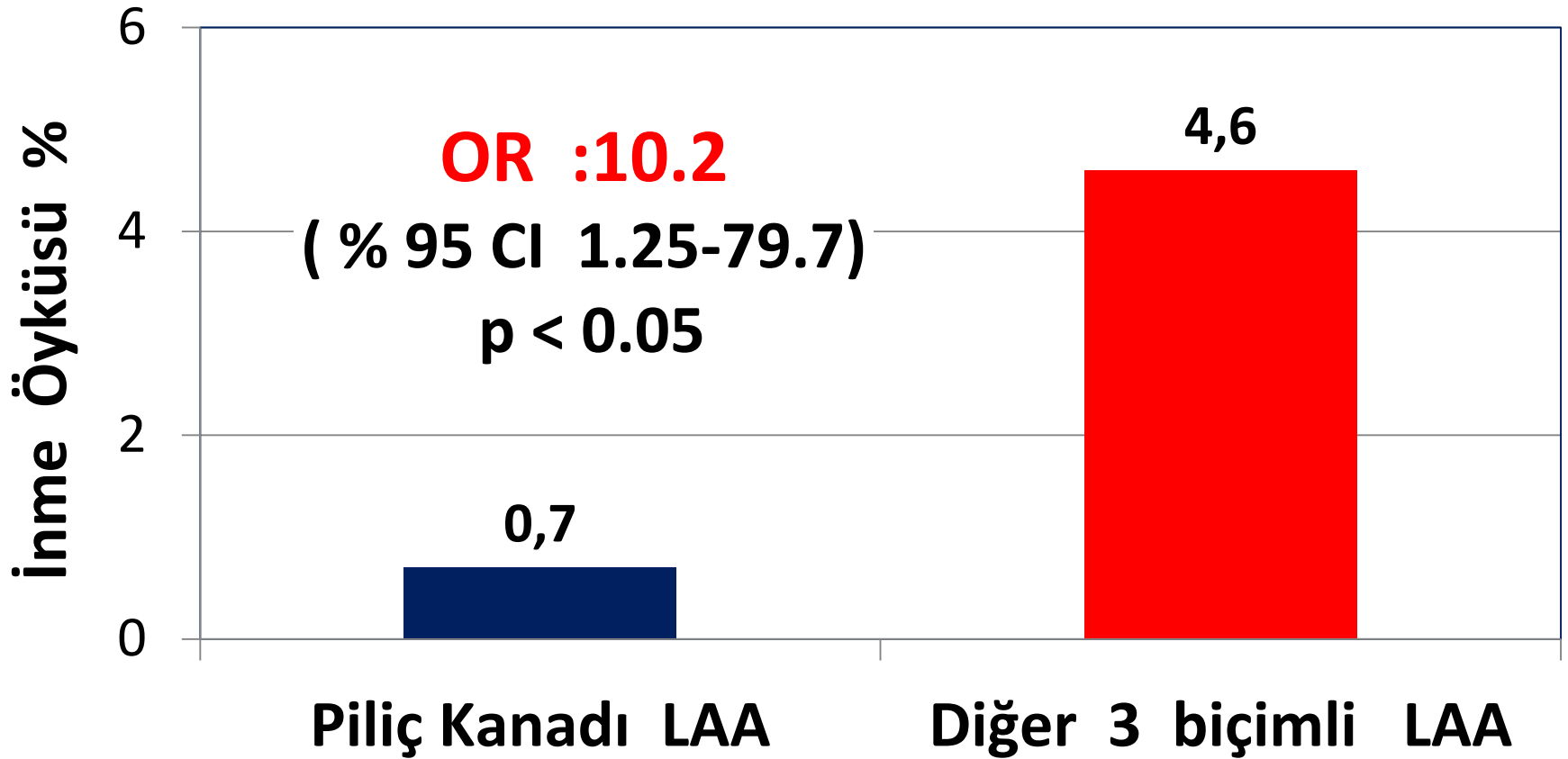


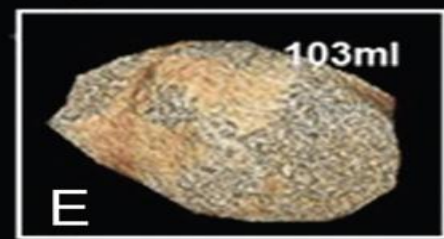
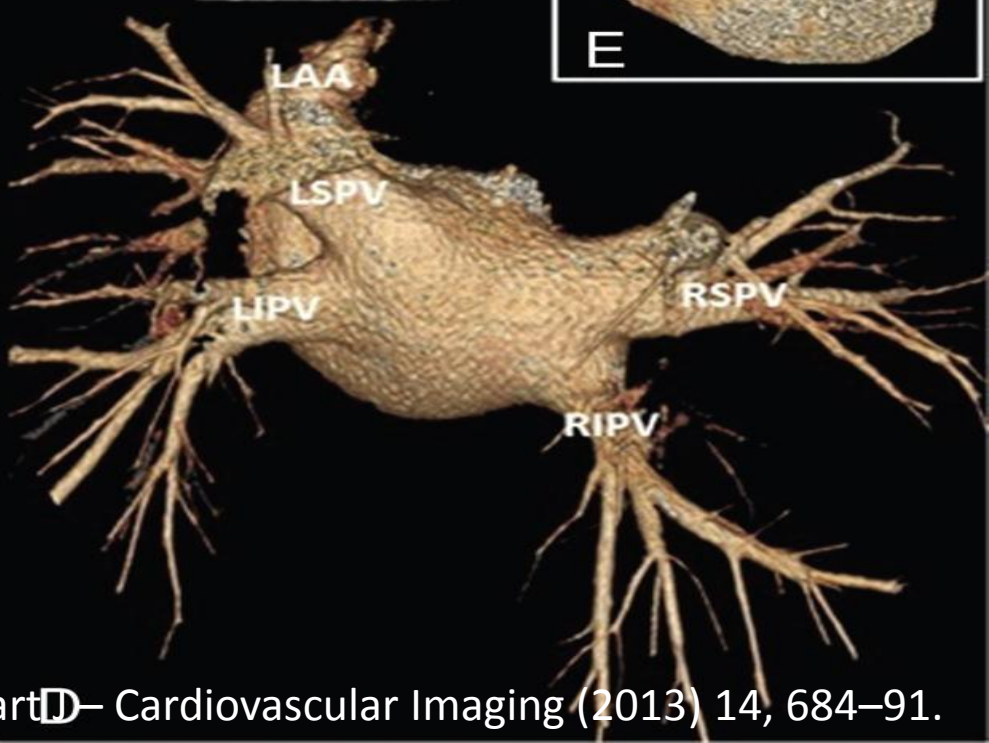
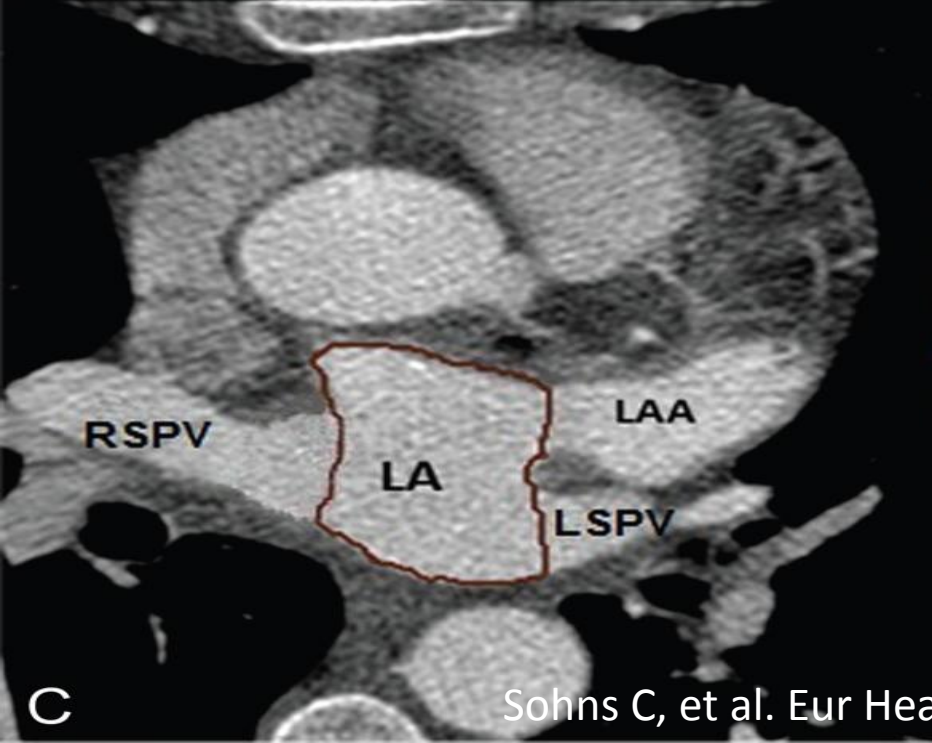
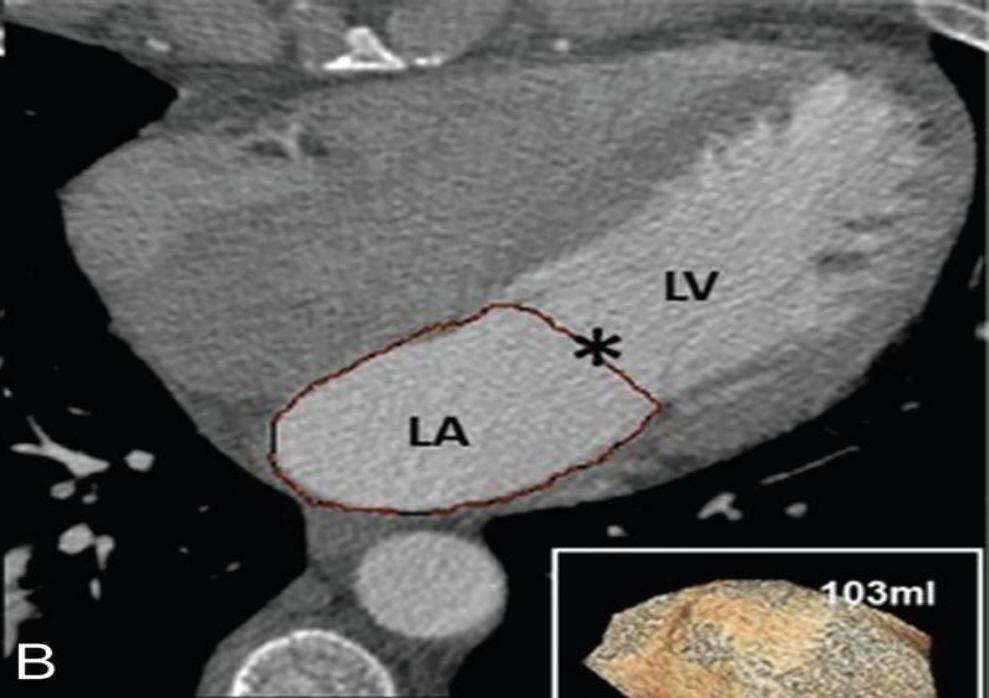
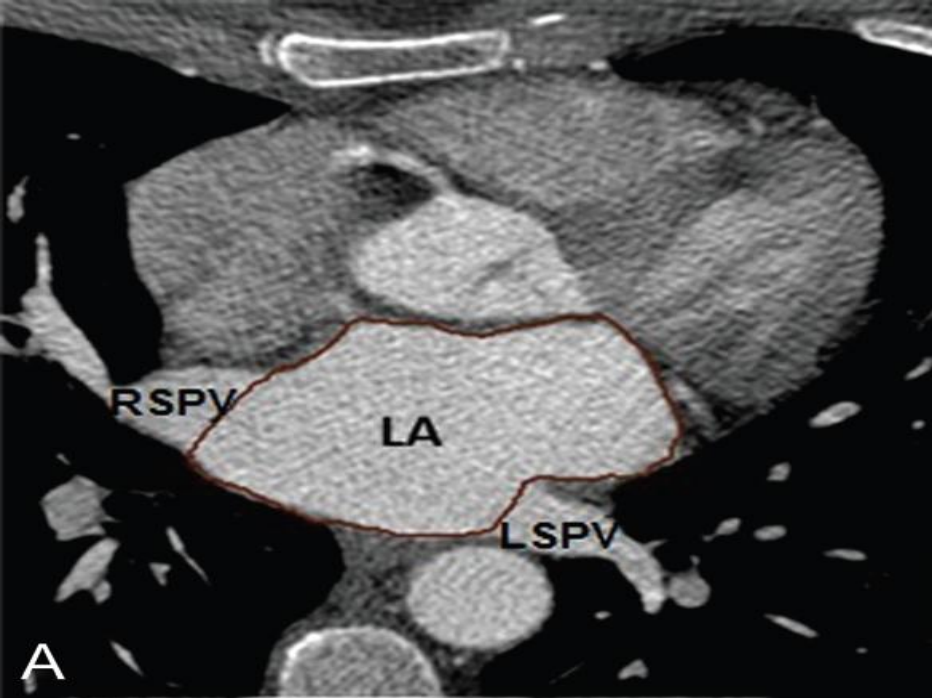
LAA Morfolojisi ve İnme Öyküsü %

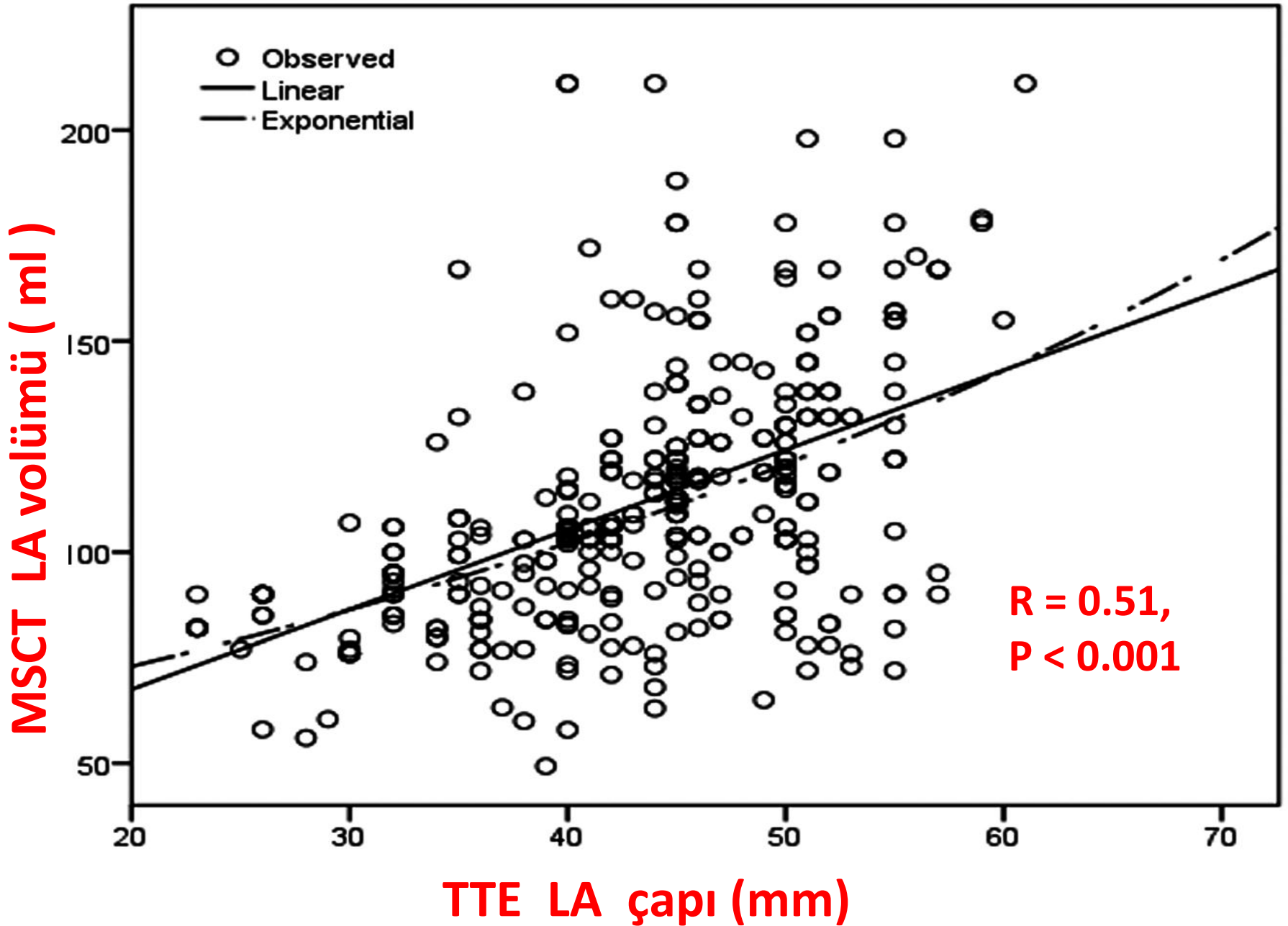
Di Biase L, et al. J Am Coll Cardiol 2012;60:531-8.



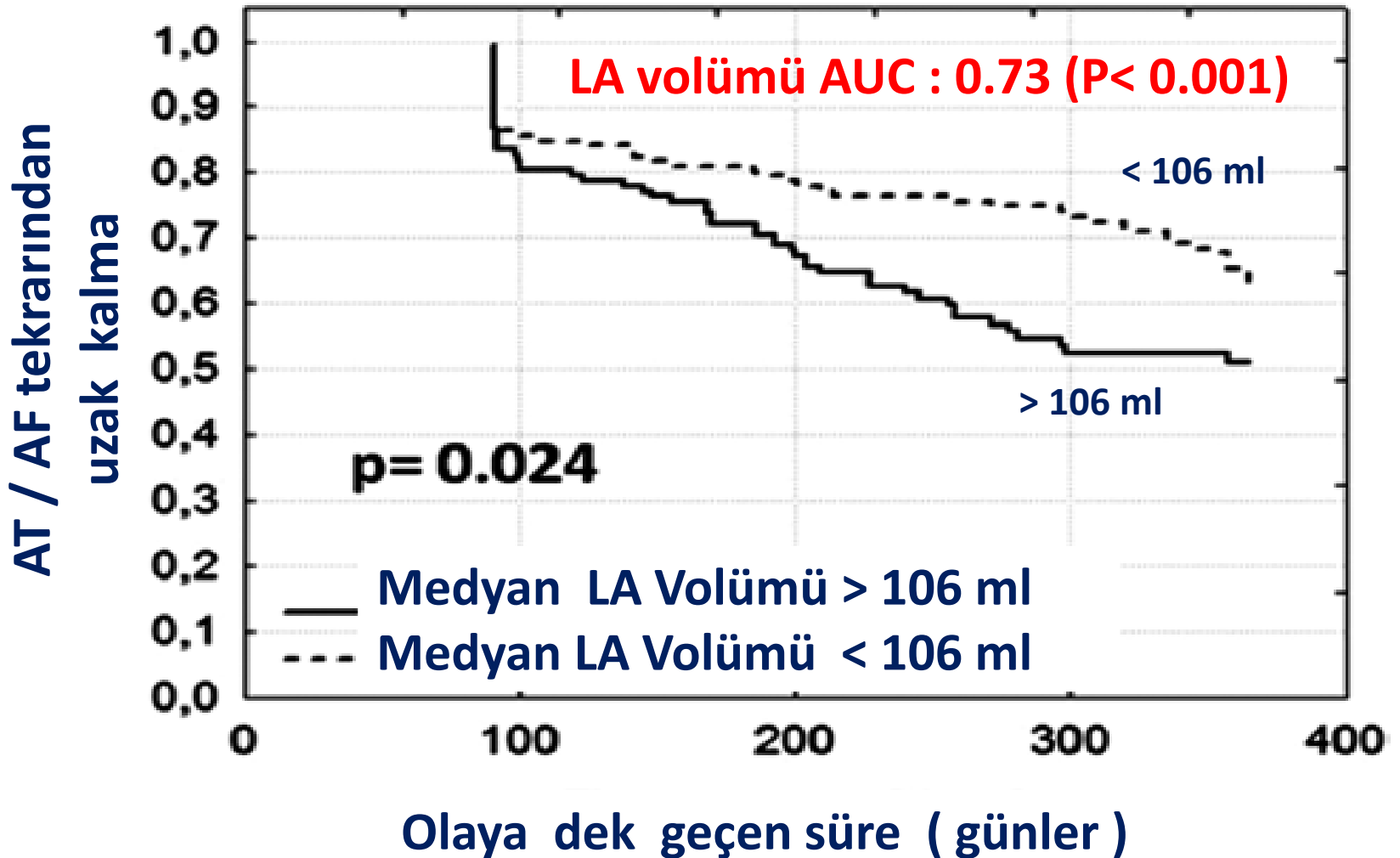
Piliç Kanadı biçimine göre diğer üç biçimli LAA düşük CHADS2 skorlularda (0-1) inme riskini bağımsız olarak arttırıyor.







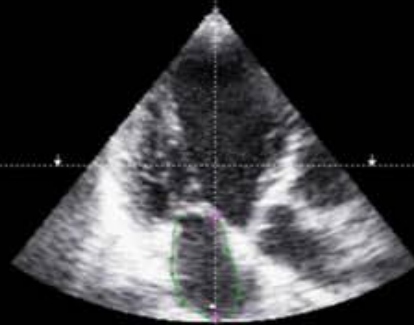
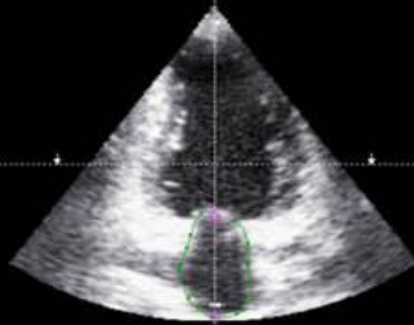
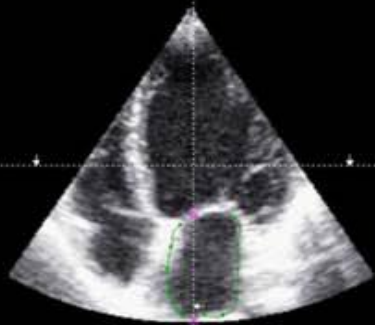
Paroksizmal AF ($p < 0.006$) ve LA volümü < 106 mL ($p < 0.04$) PVA başarısının bağımsız belirleyicileri.



4Ch

2Ch

LAX



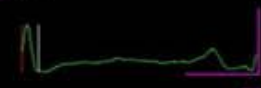
A

fine diastole



B

fine diastole



C

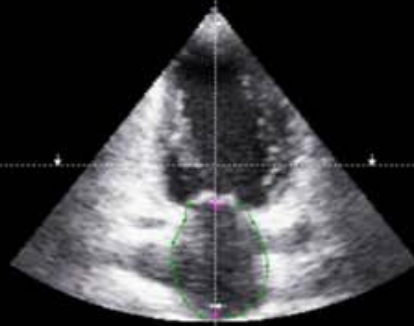
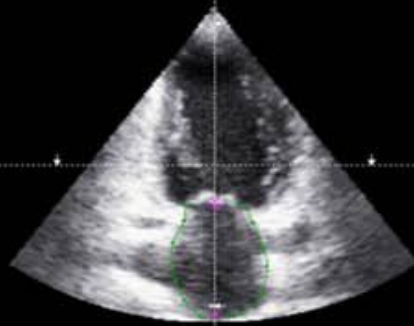
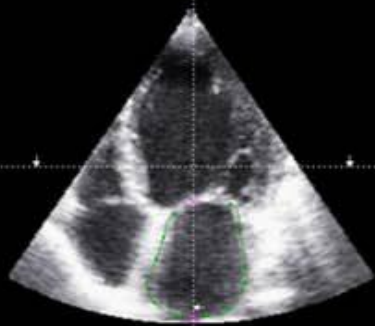
fine diastole



4Ch

2Ch

2Ch



D

fine sistole



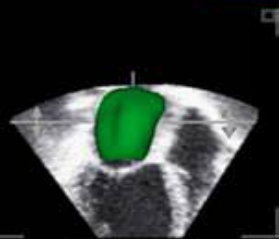
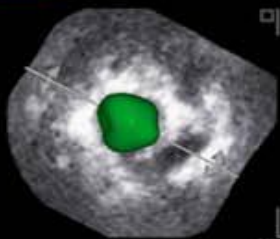
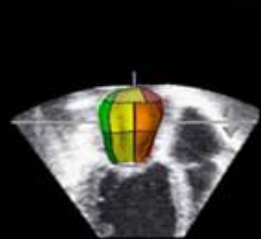
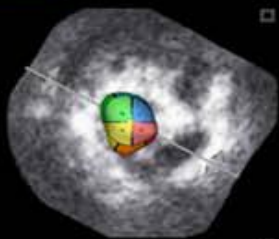
E

fine sistole



F

fine sistole

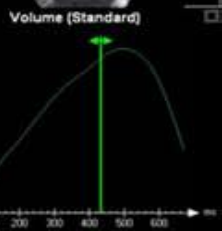


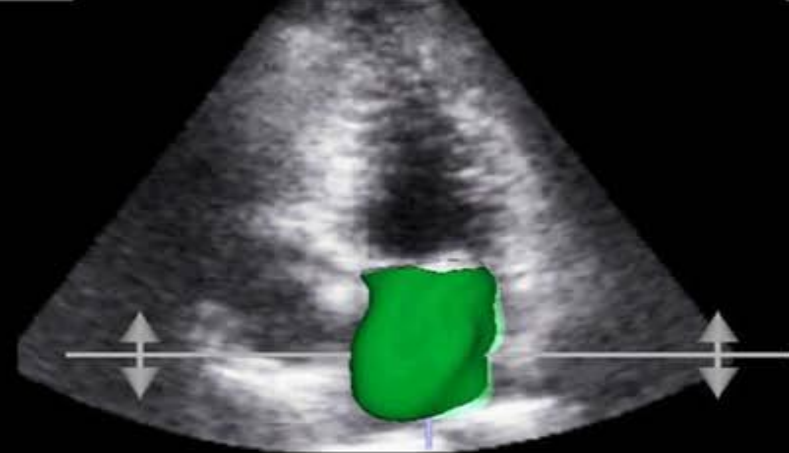
EDV 46.03 ml
 ESV 24.40 ml
 SV 21.63 ml
 EF 47.00 %



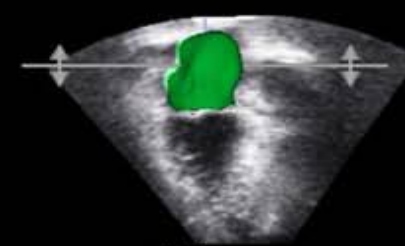
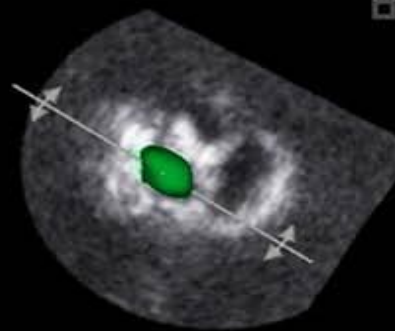
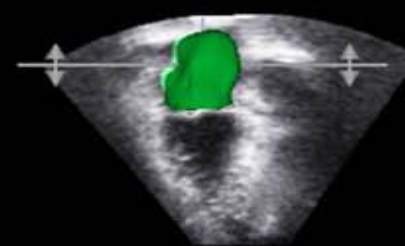
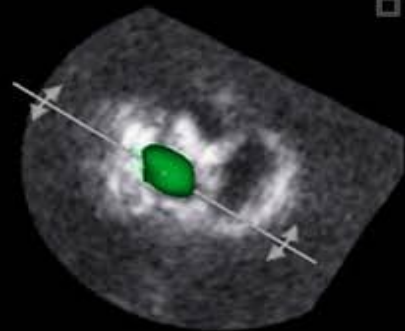
H

I

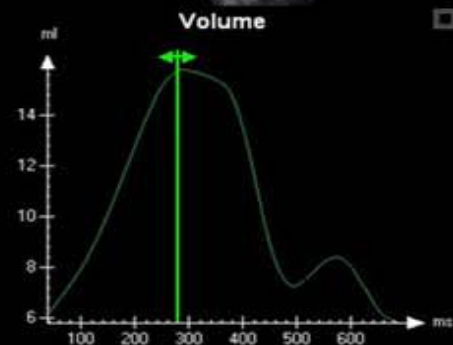
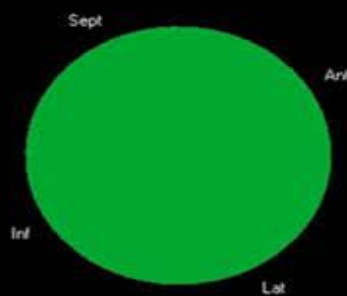
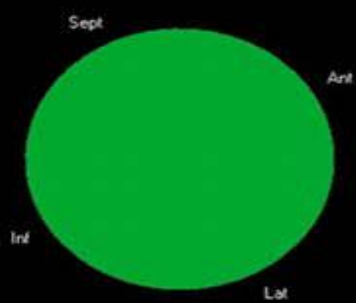


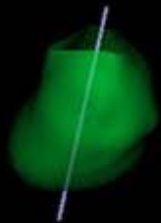


Cameli M, et al. Cardiovascular Ultrasound 2012, 10:4

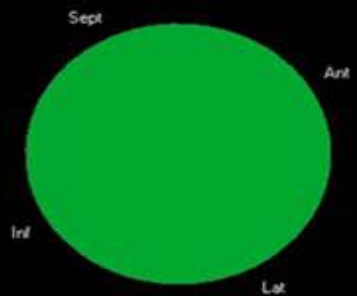
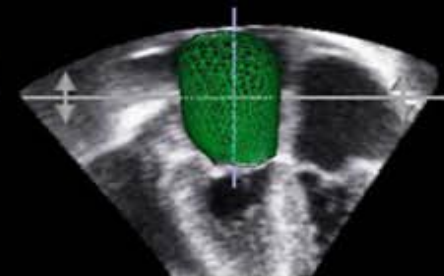
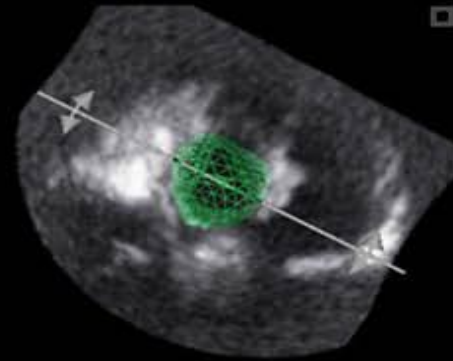
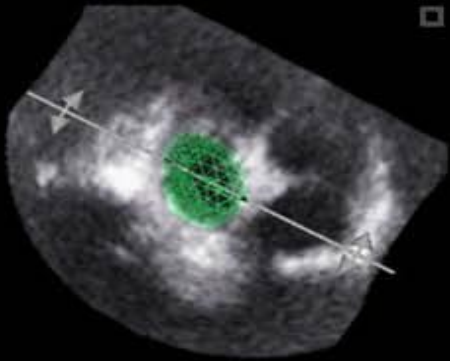


EDV 15.82 ml
ESV 5.81 ml
SV 10.01 ml
EF 63.29 %

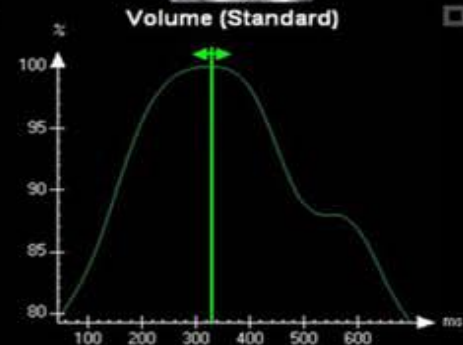
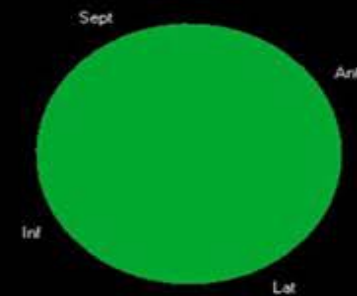




Cameli M, et al. Cardiovascular Ultrasound 2012, 10:4



EDV 78.08 ml
ESV 61.89 ml
SV 16.19 ml
EF 20.74 %



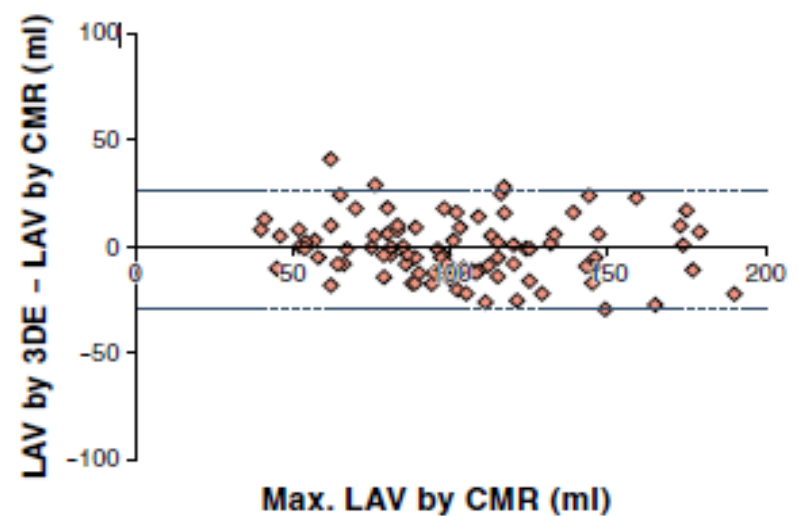
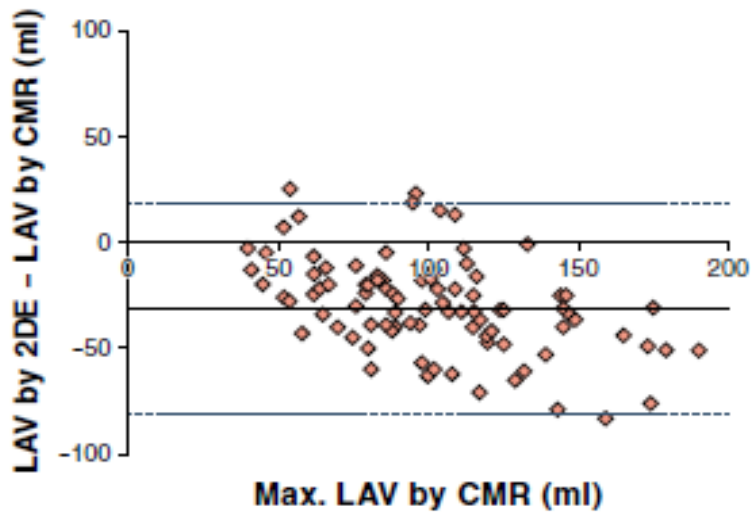
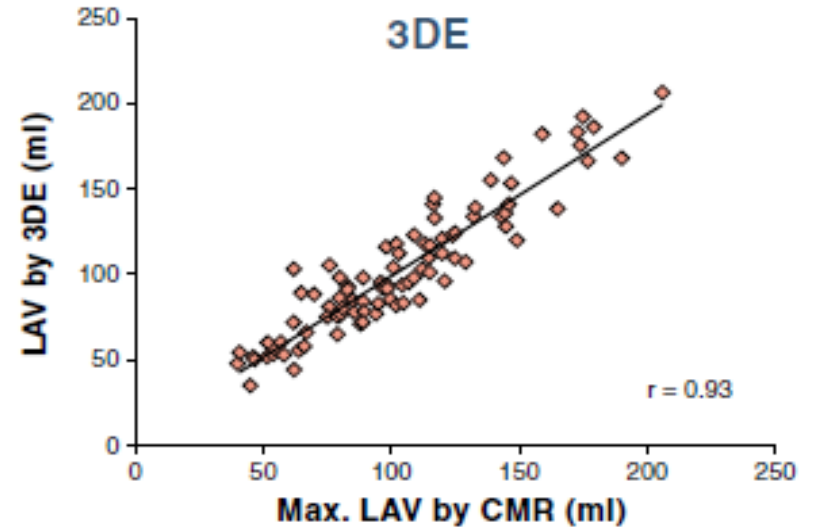
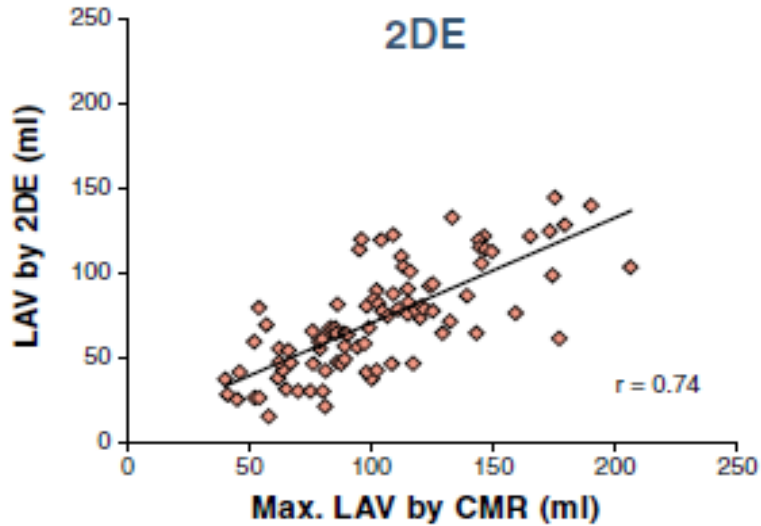
RT 3D Eko

Atriyal Volümler ve EF%

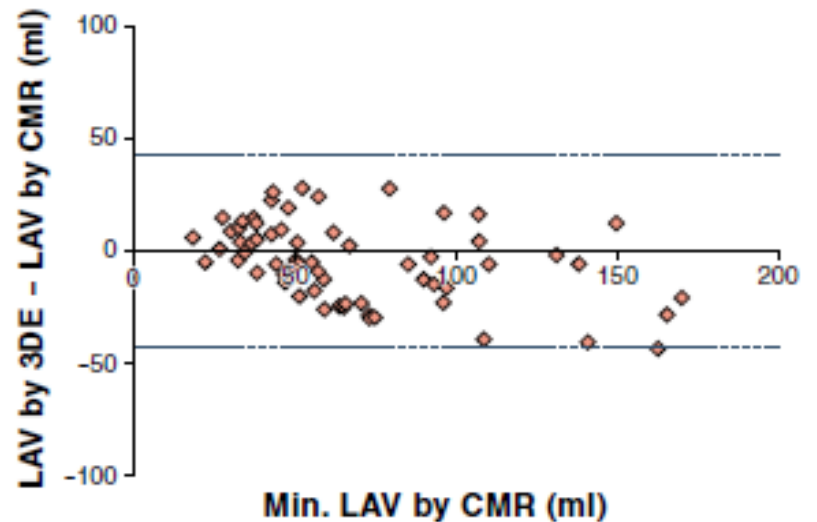
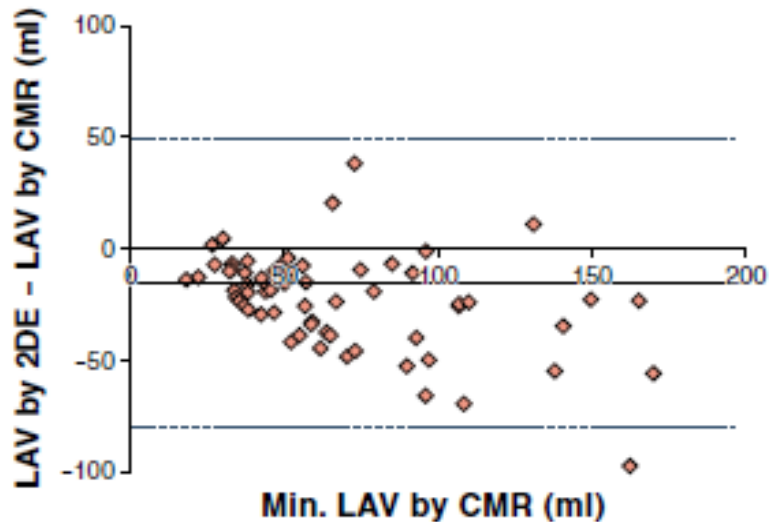
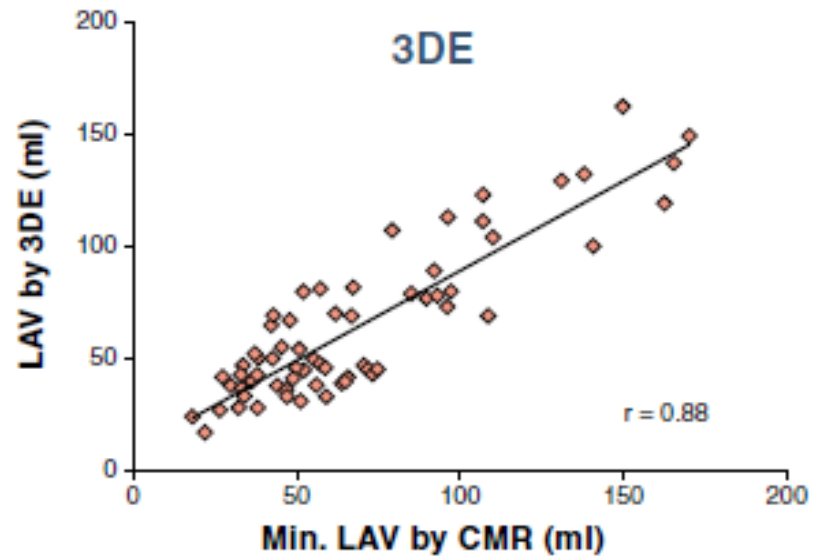
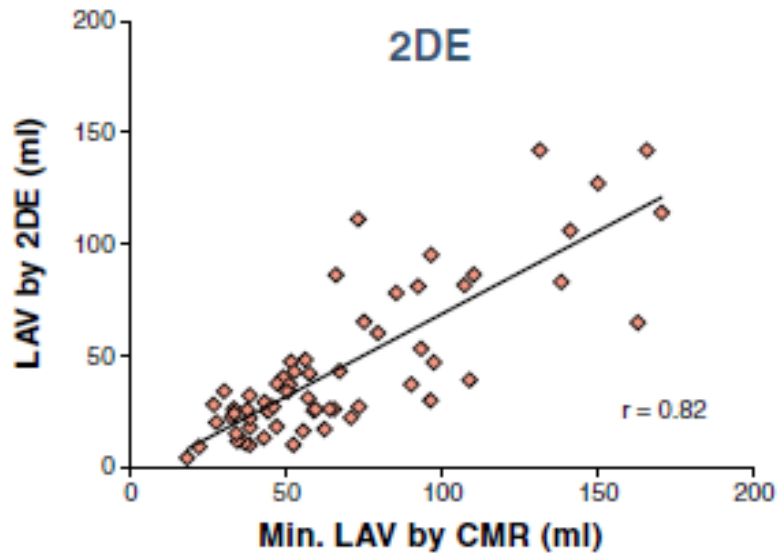
Normal değerleri

| RT3DE | Males (n = 75) | Females (n = 84) | Total Study Population (n = 159) |
|-------------------------------|-------------------|---------------------|----------------------------------|
| LAVI max (ml/m ²) | 15-42 | 15-39 | 15-41 |
| LAVI min (ml/m ²) | 6-20 | 5-18 | 5-19 |
| LAEF (%) | 46-77 | 44-80 | 45-79 |
| RAVI max (ml/m ²) | 18-50 | 17-41 | 18-47 |
| RAVI min (ml/m ²) | 7-22 | 5-18 | 5-20 |
| RAEF (%) | 46-74 | 48-83 | 46-80 |

2D ve 3D Eko ve CMR (Max LA Volüm)



2D ve 3D Eko ve CMR (Min LA Volüm)





End-systole



Protodiastole



Atrial Systole

PALS

Peak atrial longitudinal strain



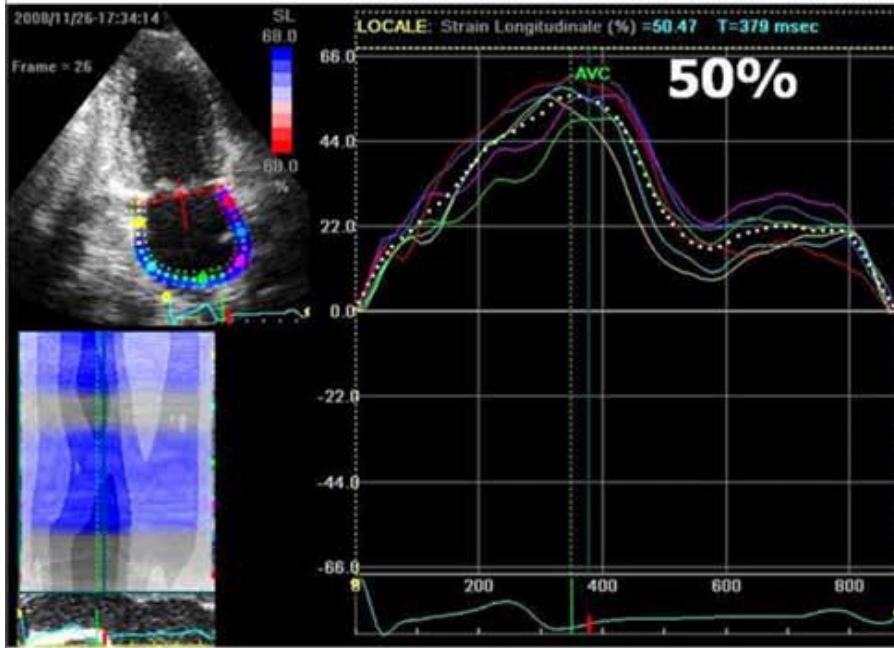
PACS

peak atrial contraction strain

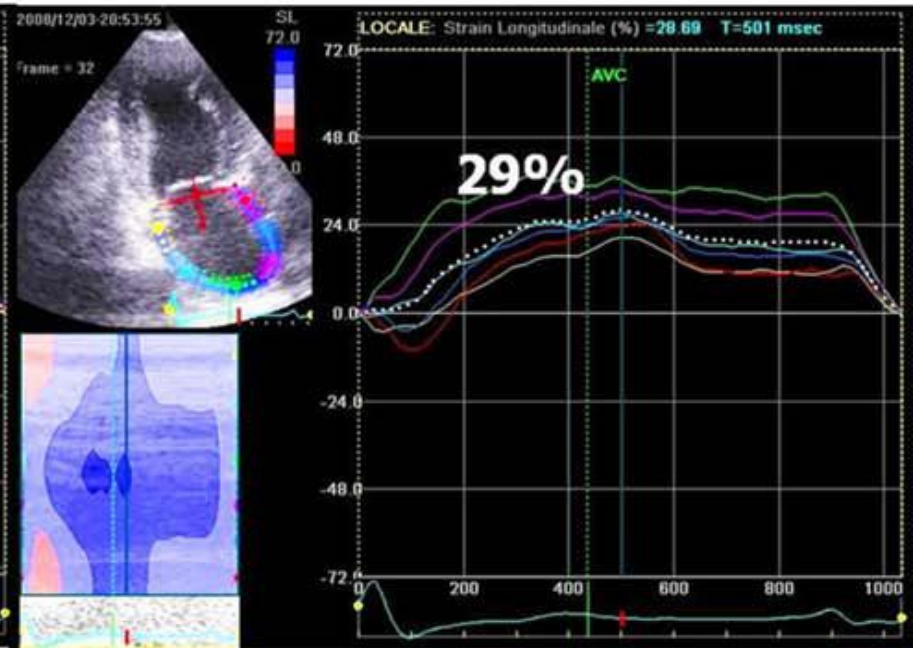
Pik Atriyal Longitudinal Strain ve Pik Atriyal Longitudinal Straine dek geçen süre (TPLS) Referans Değerleri

| | Mean \pm DS | 5 ^o -95 ^o Percentile |
|------------------|------------------|--|
| PALS (%) | | |
| Global | 42.2 \pm 6.1 | 32.2 - 53.2 |
| 4-chamber | 40.1 \pm 7.9 | 29.0 - 53.6 |
| 2-chamber | 44.3 \pm 6.0 | 35.2 - 52.7 |
| TPLS (ms) | | |
| Global | 368.0 \pm 29.9 | 322.9 - 430.4 |
| 4-chamber | 364.2 \pm 42.6 | 300.8 - 436.9 |
| 2-chamber | 367.4 \pm 34.1 | 326.4 - 435.2 |

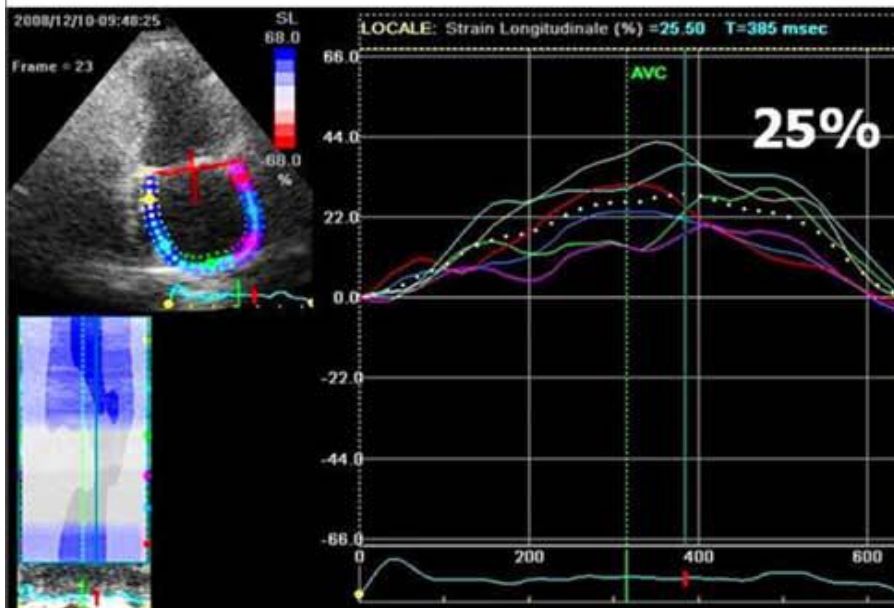
Sağlıklı Kontrol



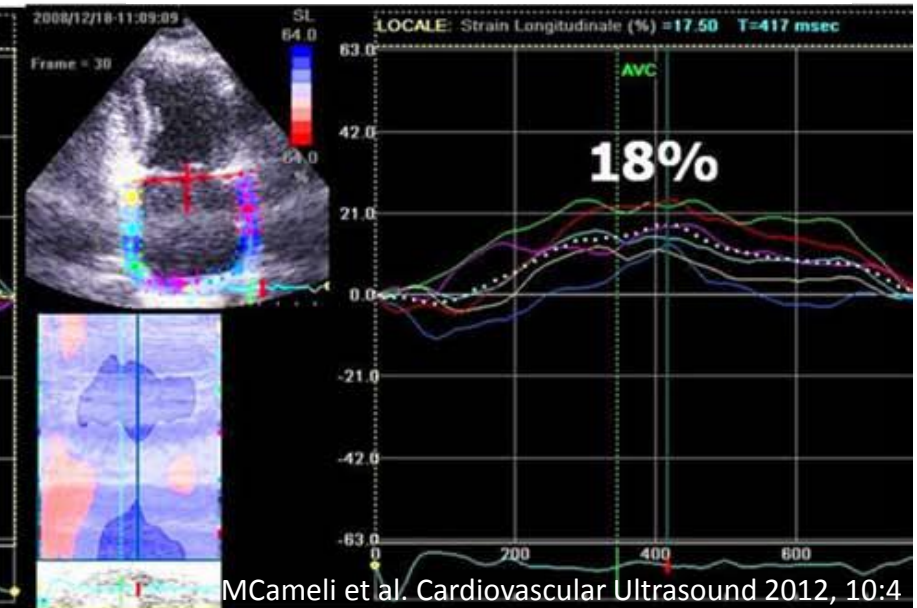
Hipertansiyon



Diyabet

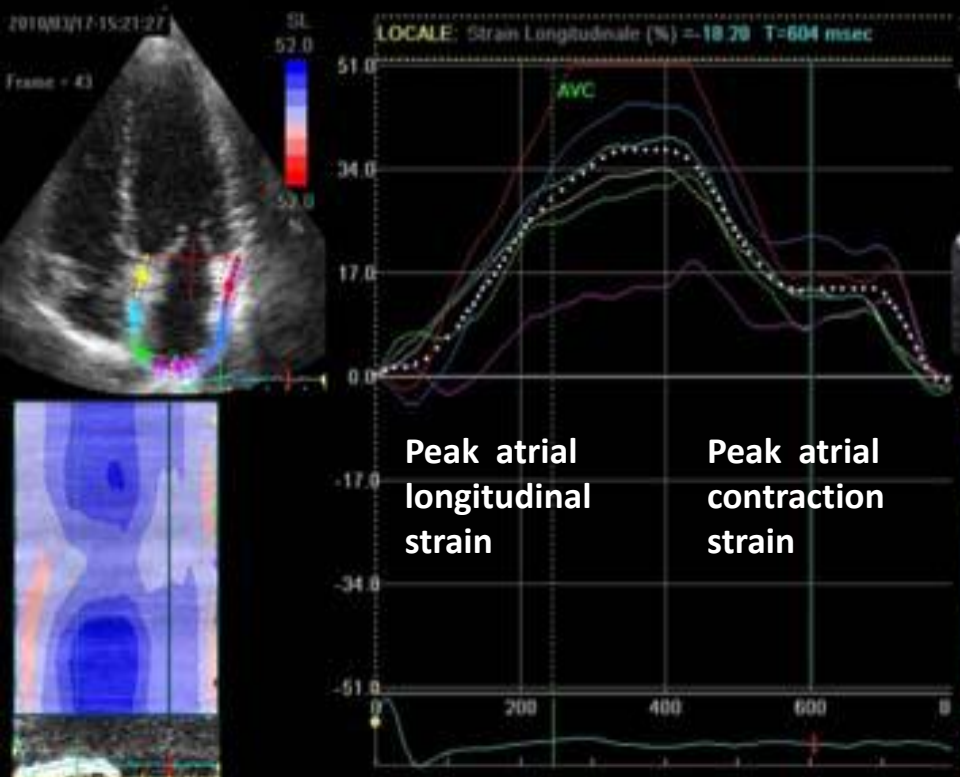


Hipertansiyon + Diyabet

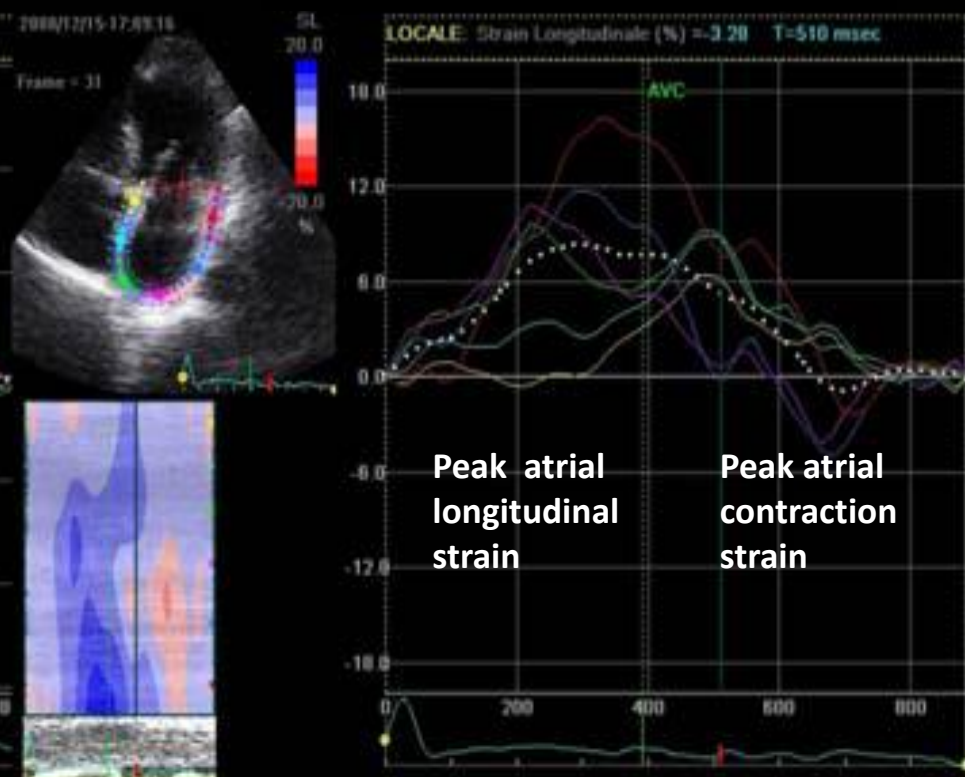


Pik LA kontraksiyon Strain ve Atriyal Ritm

Sinus Ritmi



Atriyal Fibrilasyon



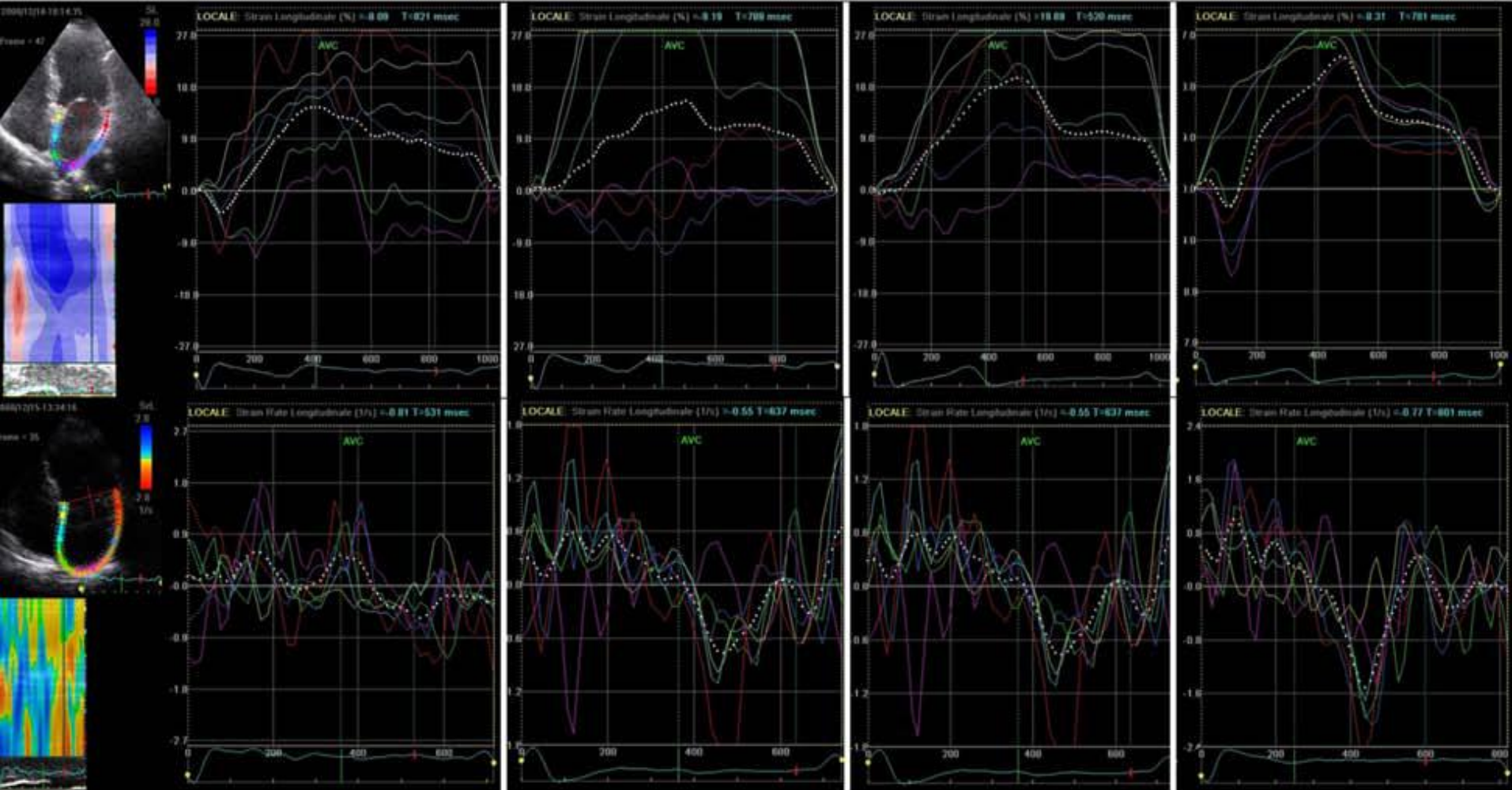
Kardiyoversiyon sonrası LA Strain ve SR seyri

KV Öncesi

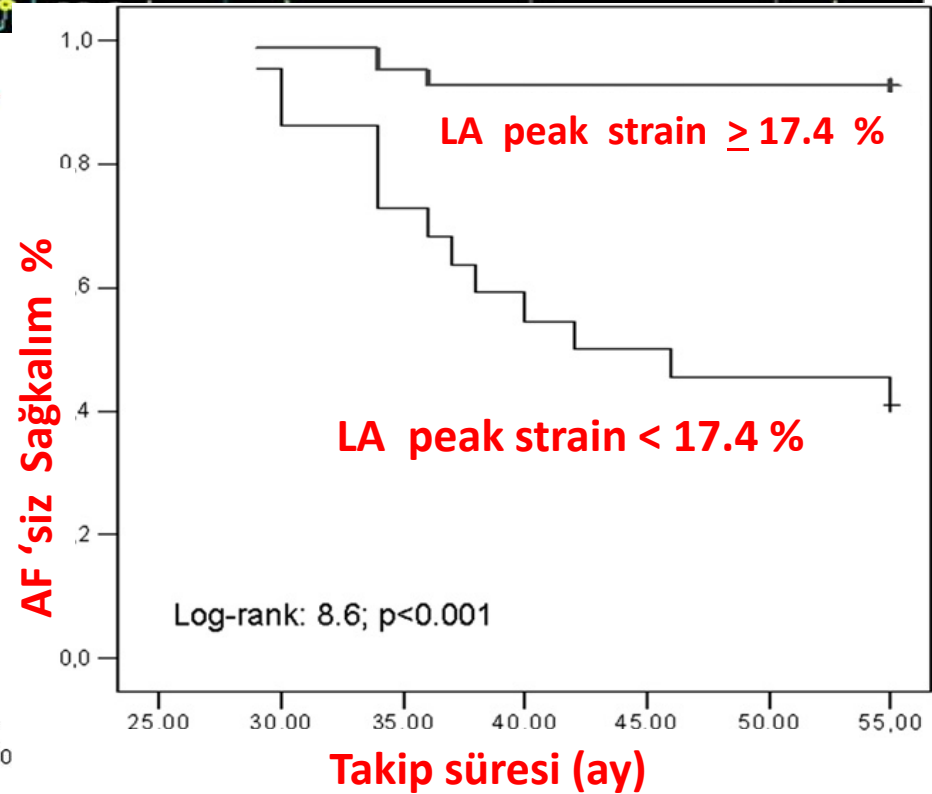
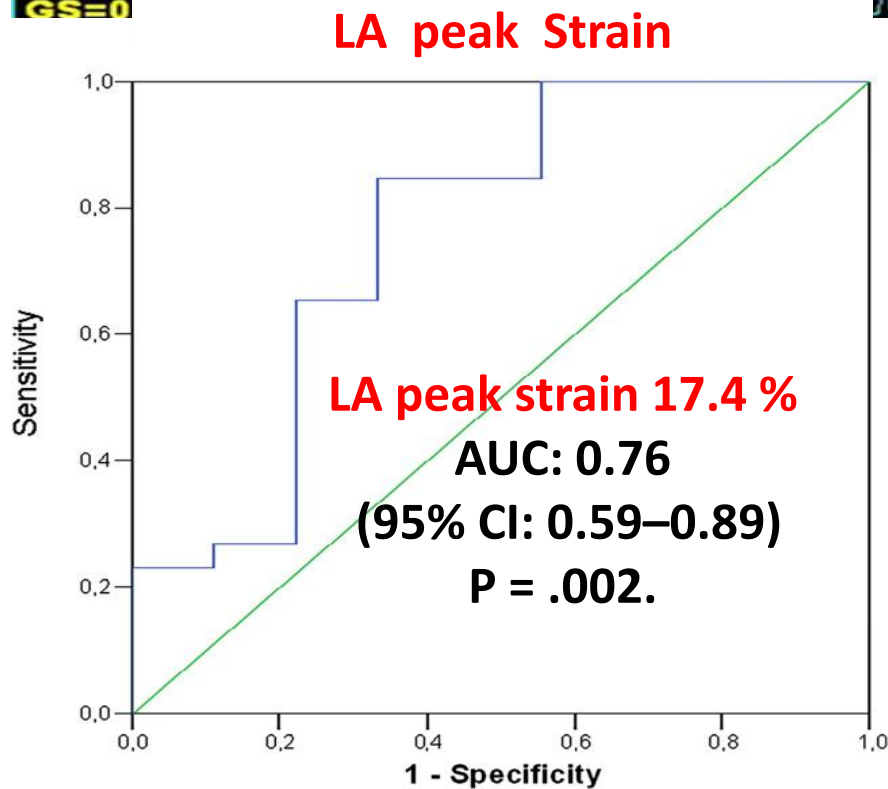
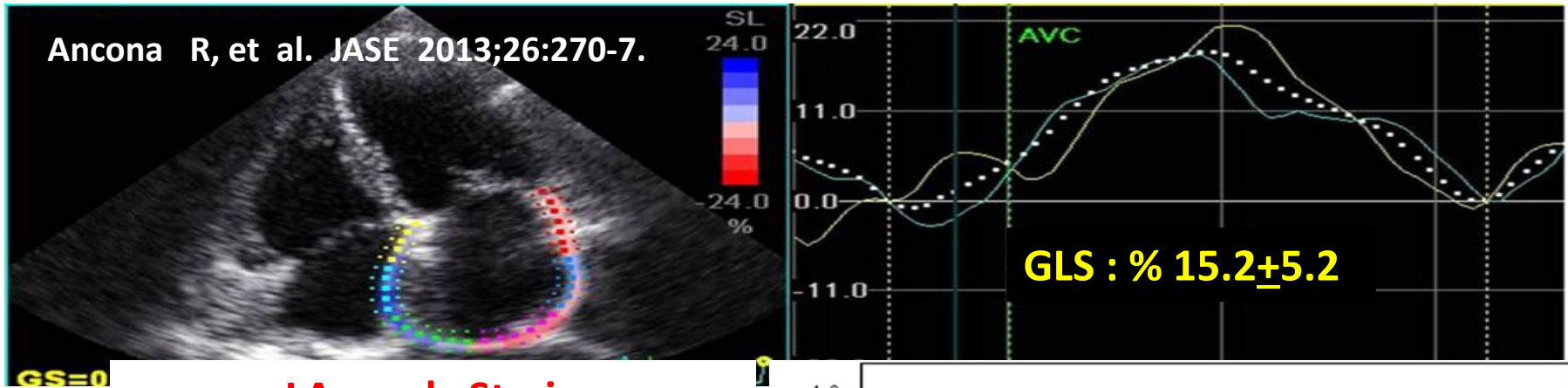
KV 24 . saat

KV 1. hafta

KV 3 . ay



MD'de LA peak Strain < 17.4 % ve AF Riski

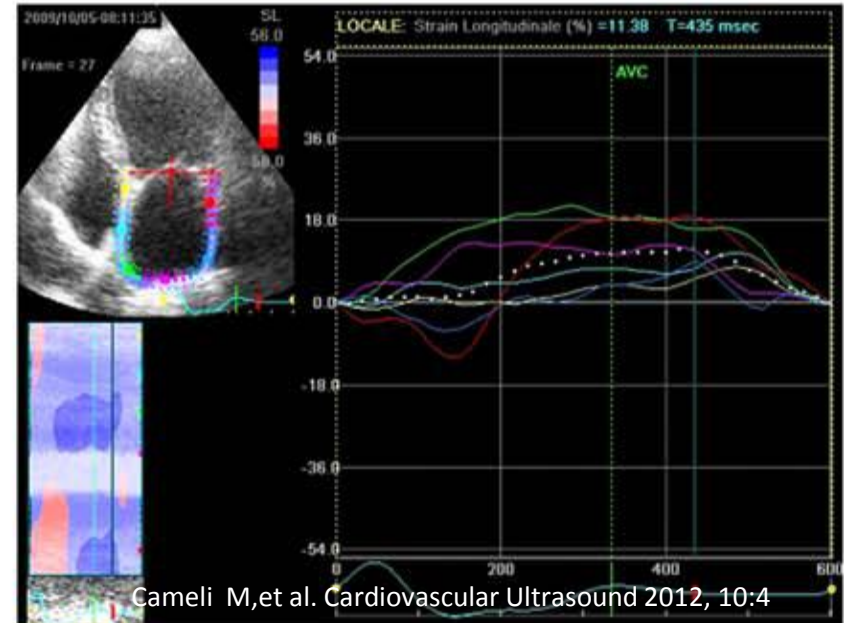
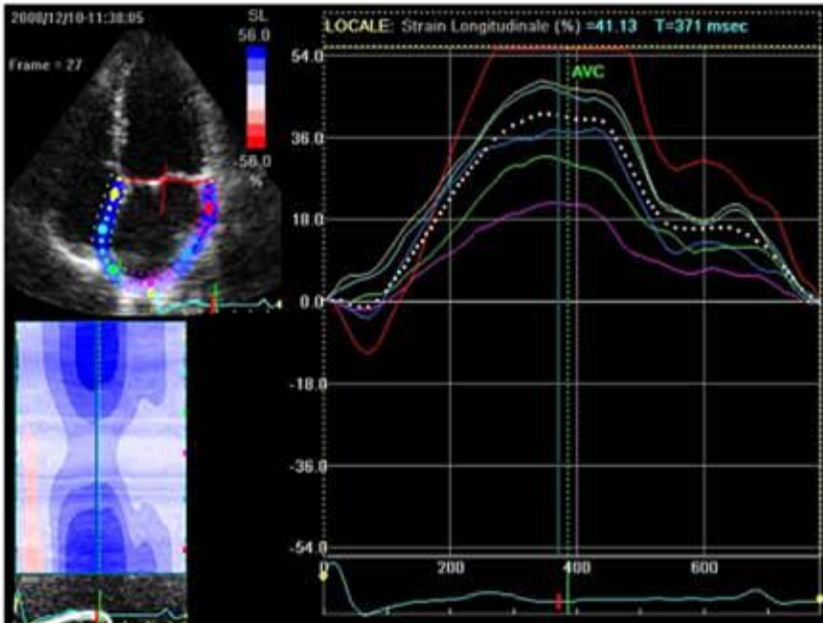
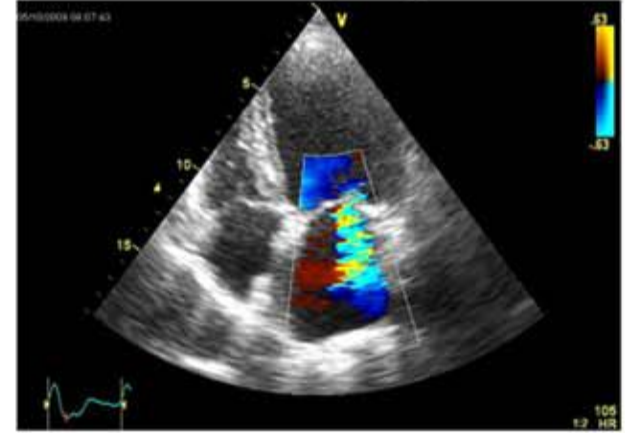


LA Strain ve Mitral yetersizliği

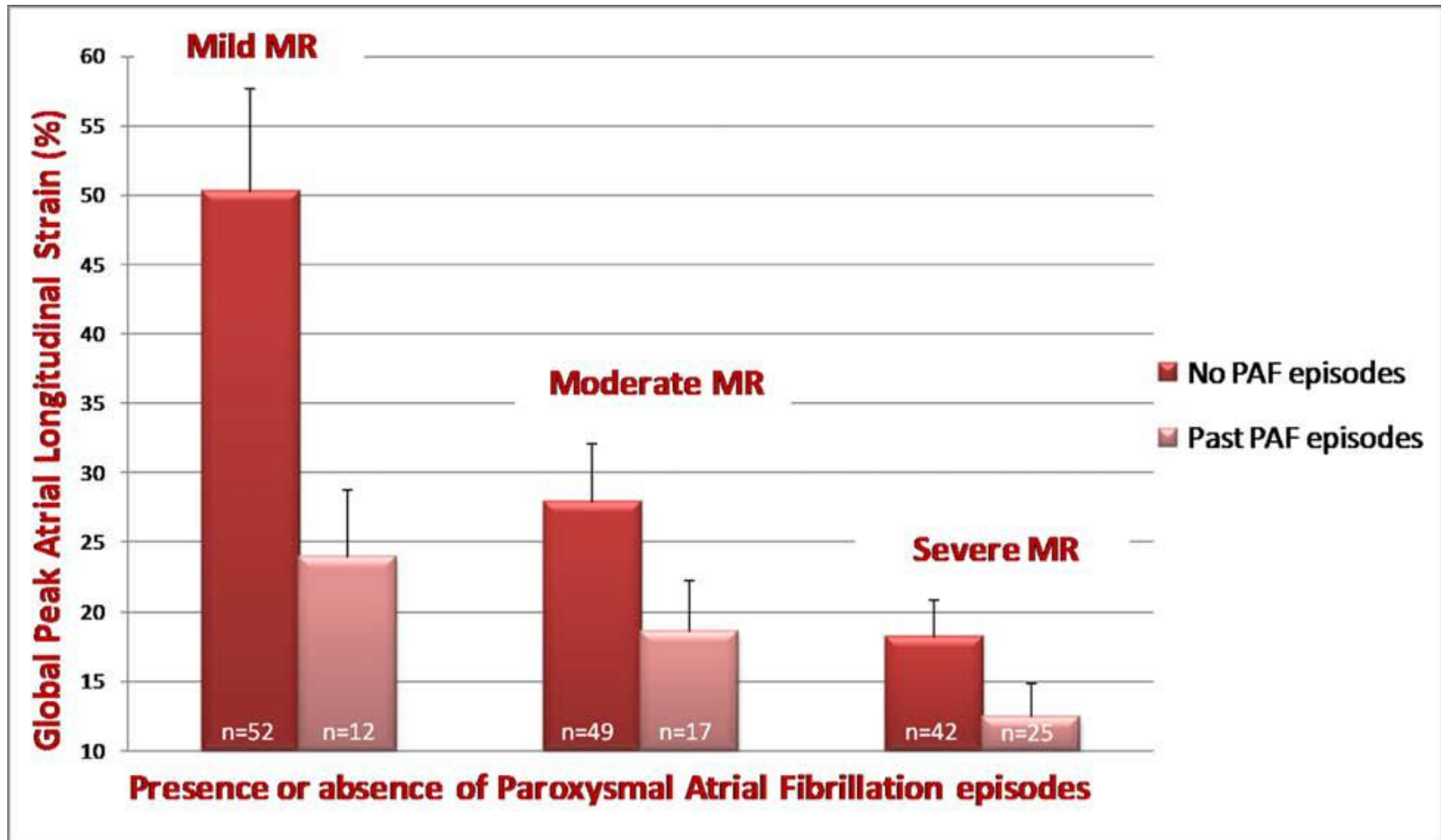
Sağlıklı Kontrol



Mitral Yetersizliği

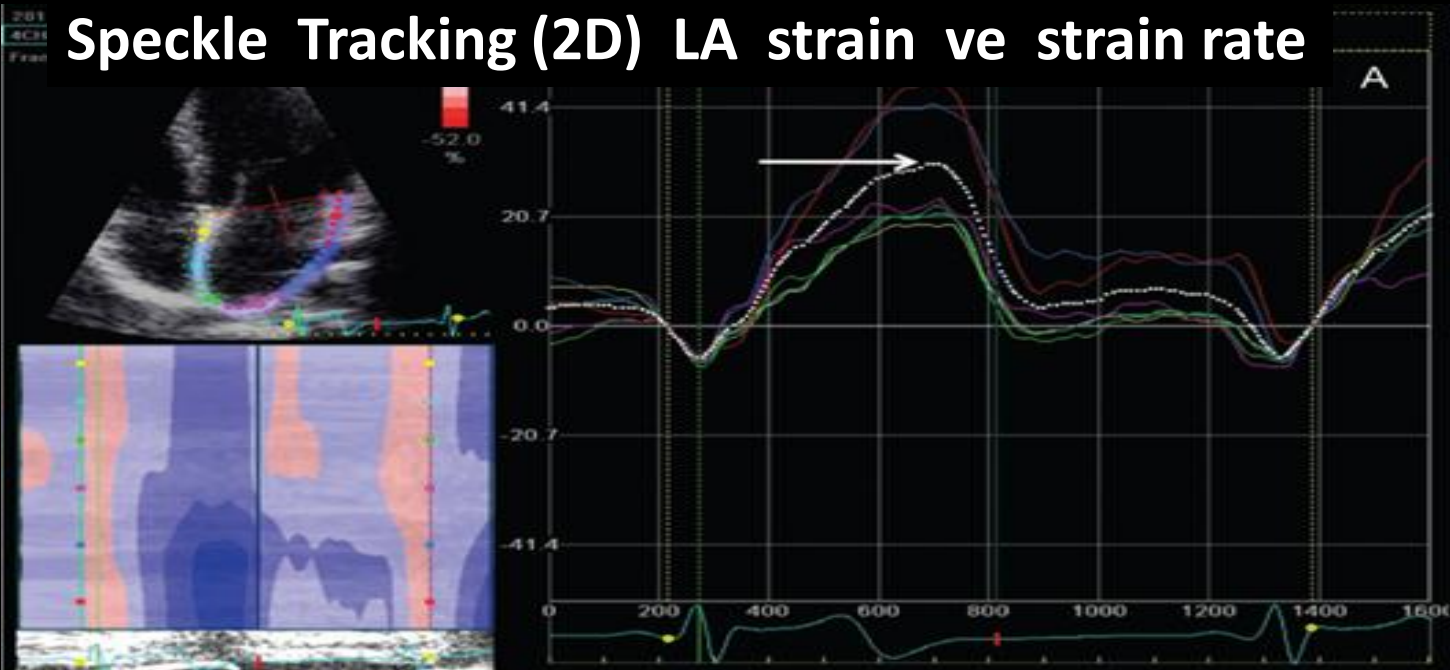


Global Peak Atrial Longitudinal Strain MY ve PAF ile ilişkisi

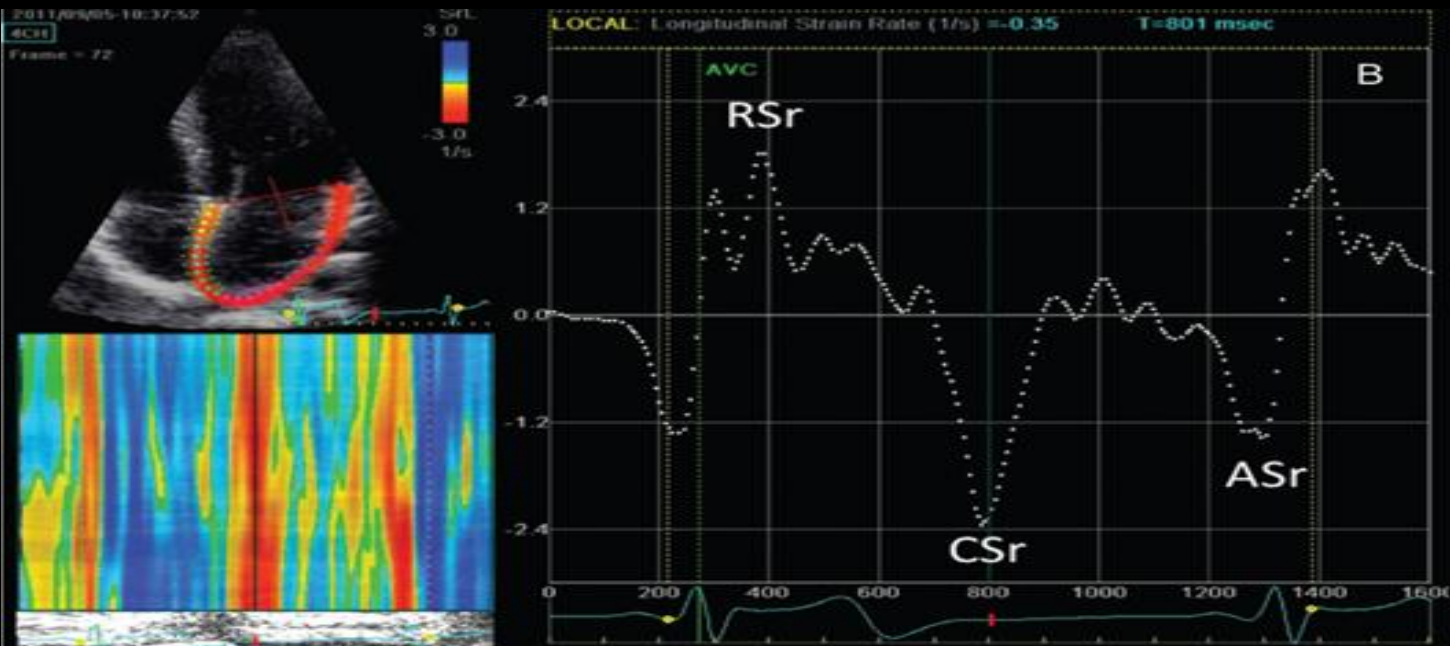


Speckle Tracking (2D) LA strain ve strain rate

LA
strain

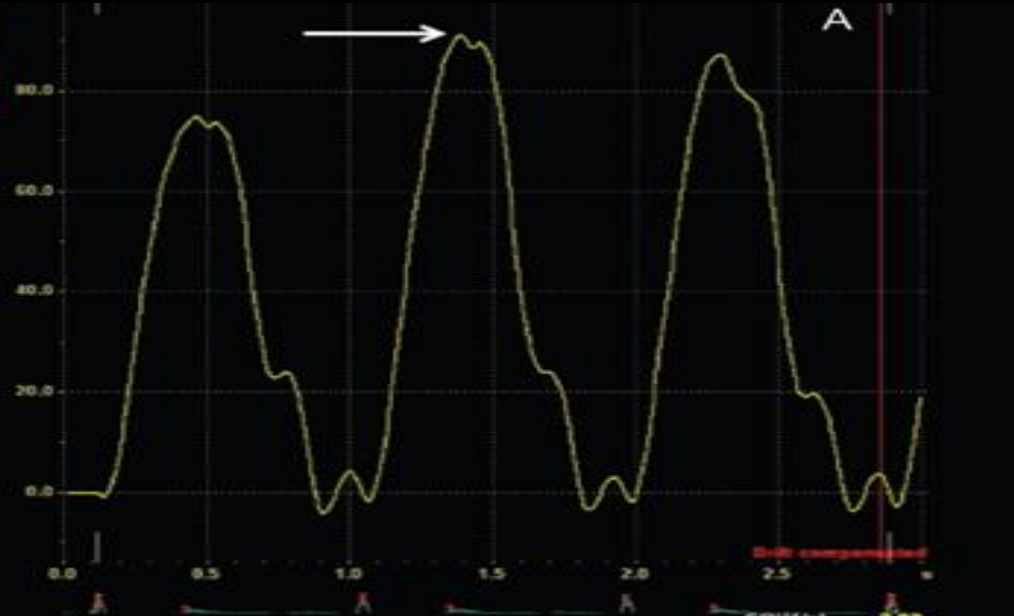
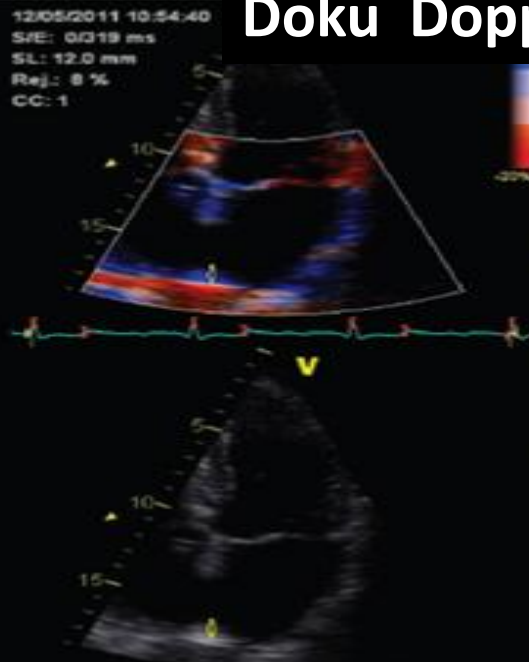


LA
Strain
Rate

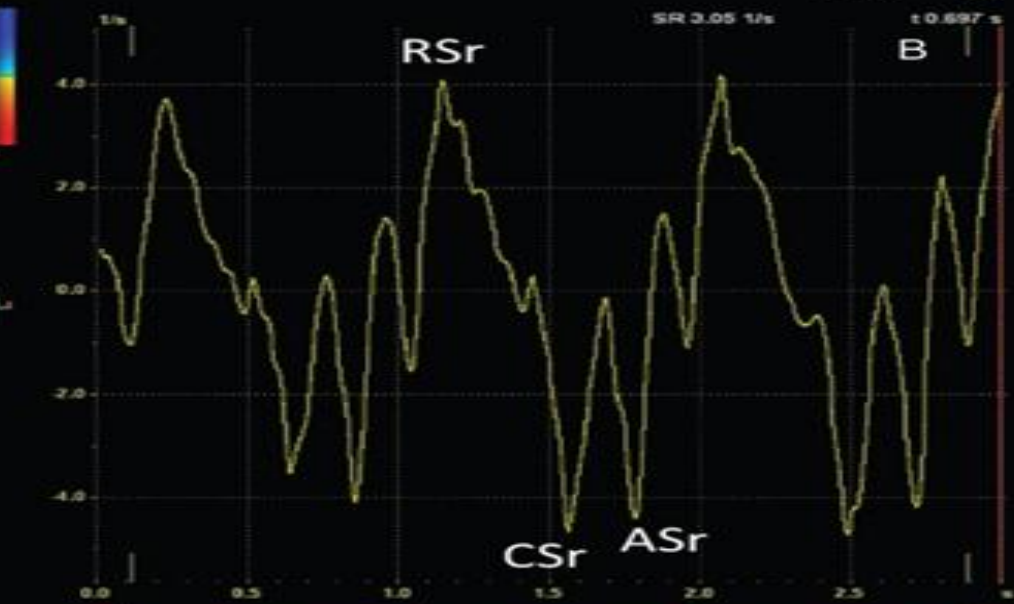
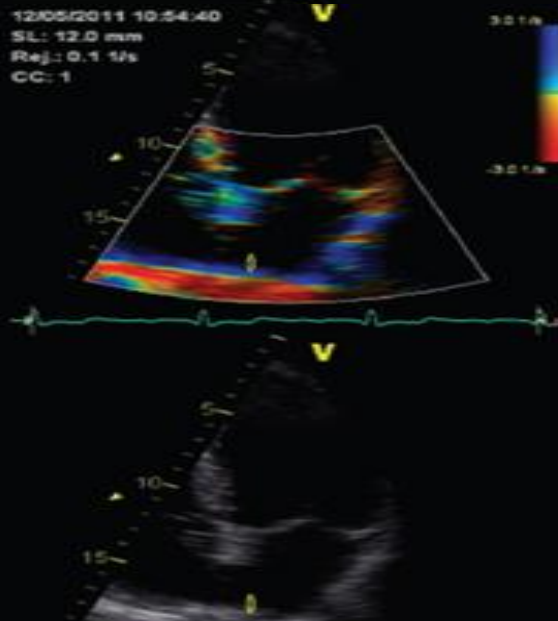


Doku Doppler LA strain ve strain rate

LA
strain

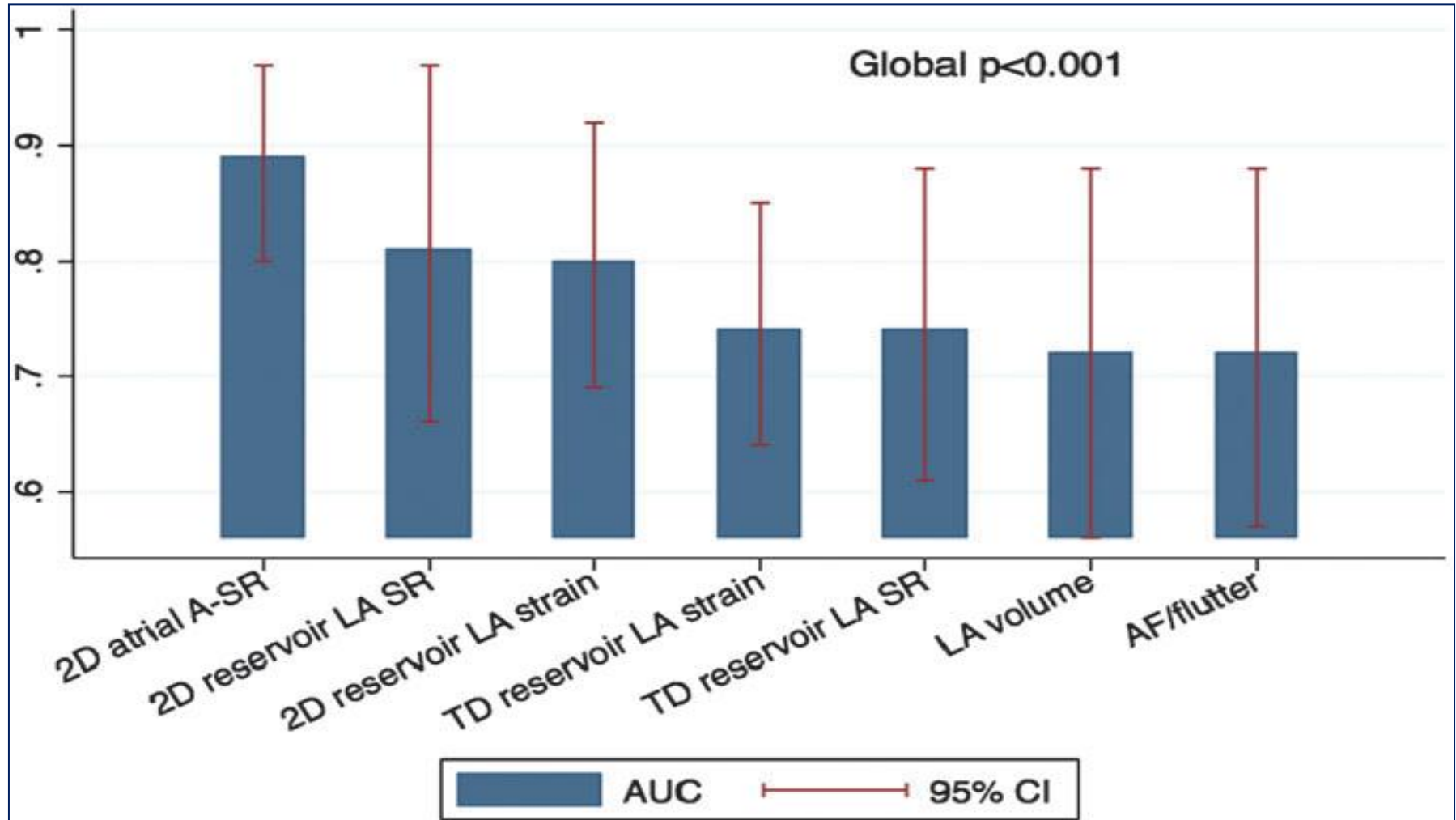


LA
Strain
Rate

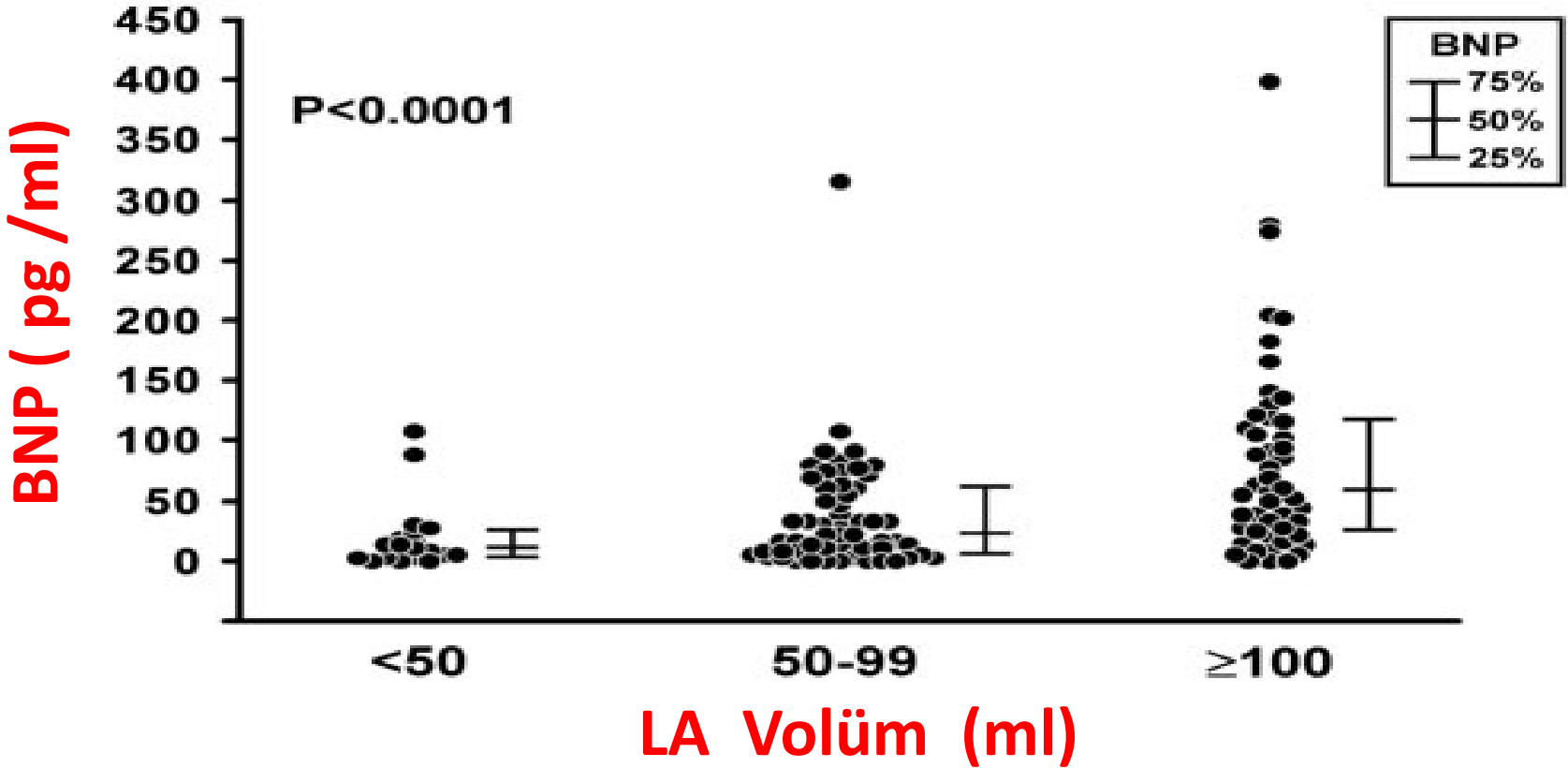


Orta-İleri LA SEK Öngörüsünde ROC Değerleri 2D ve Doku Doppler LA Strain / SR ve LA Volüm

Leong DP, et al. Eur Heart J– Cardiovascular Imaging 2013; 14, 898–905



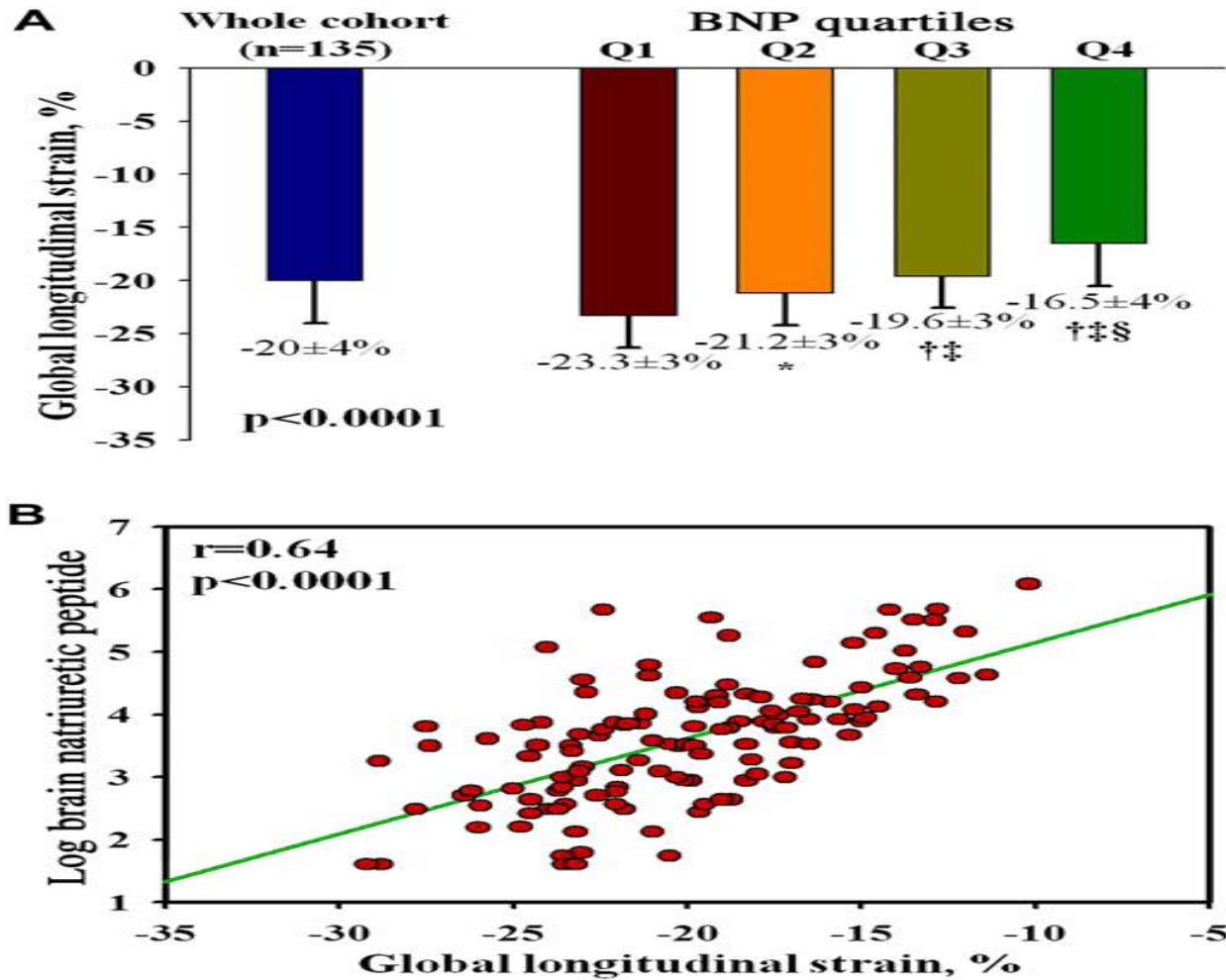
Organik MY' de LA Volüm BNP düzeyini bağımsız olarak belirler.

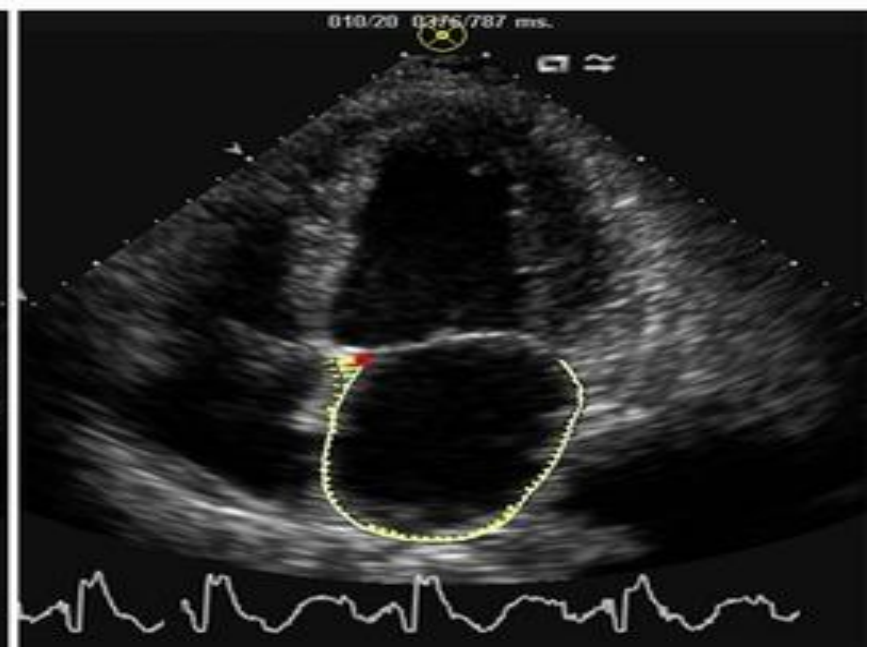
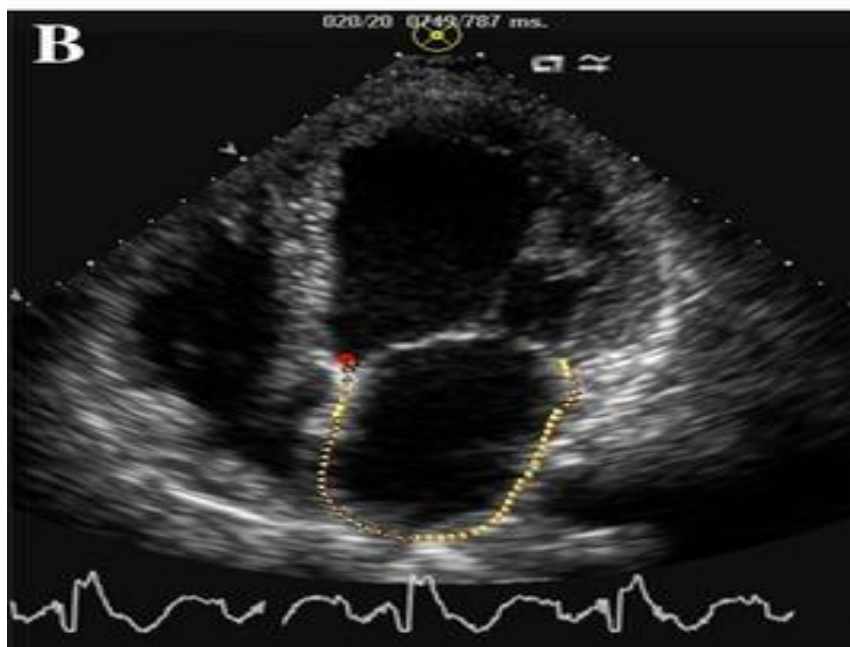
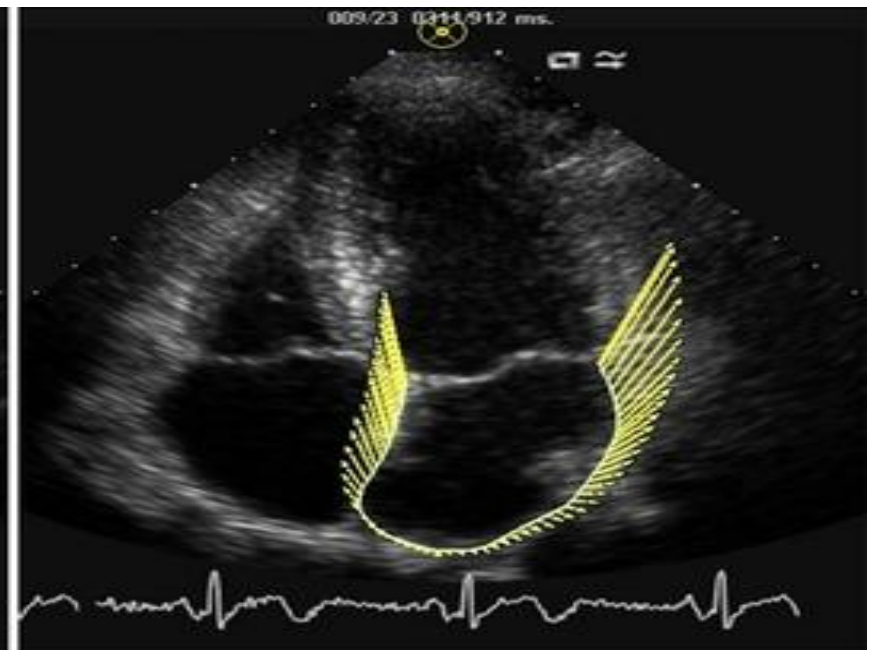
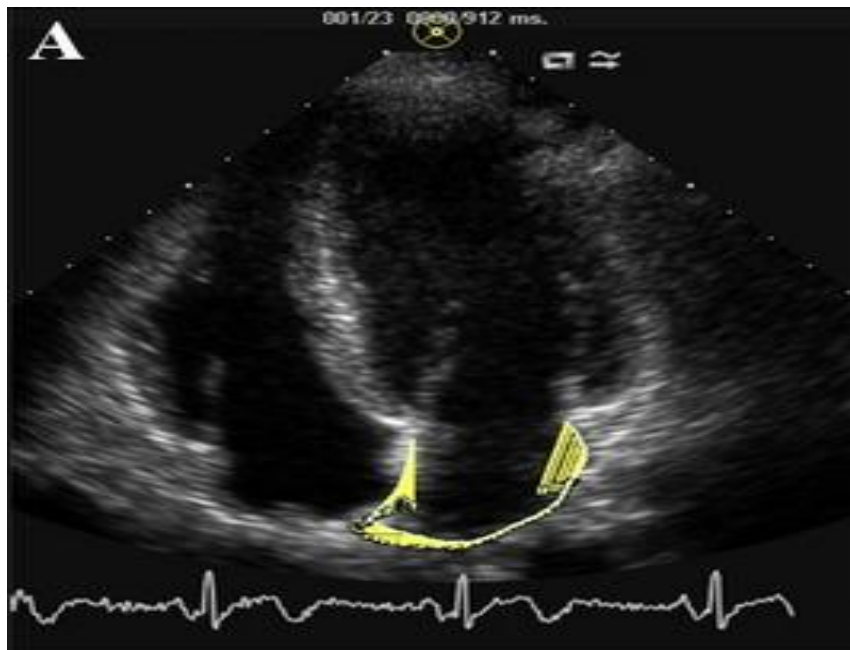


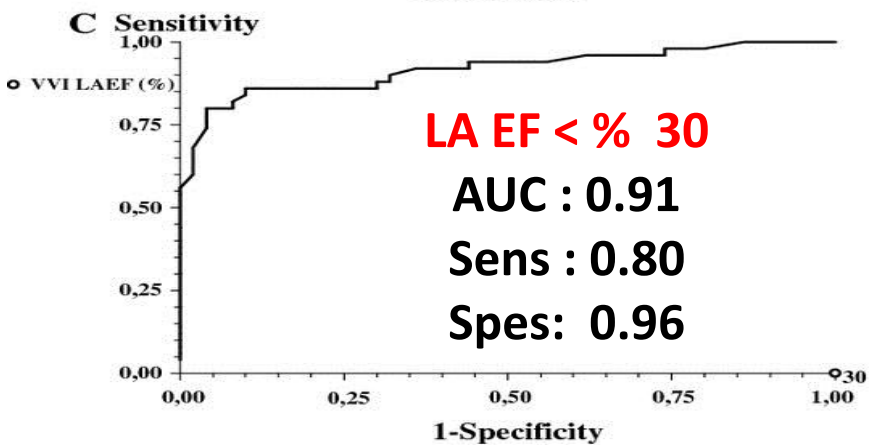
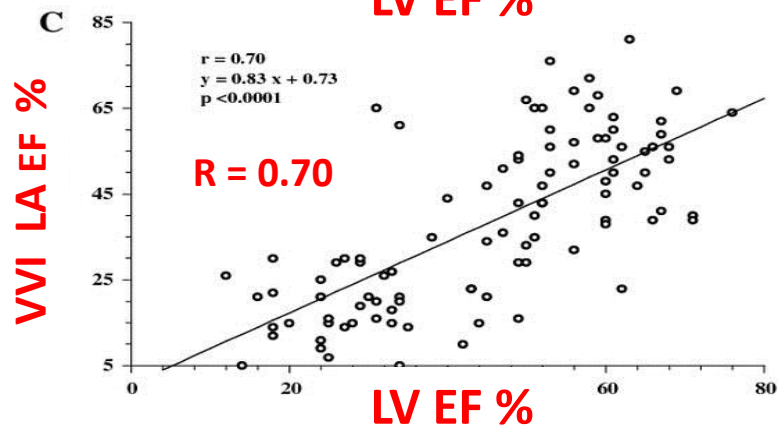
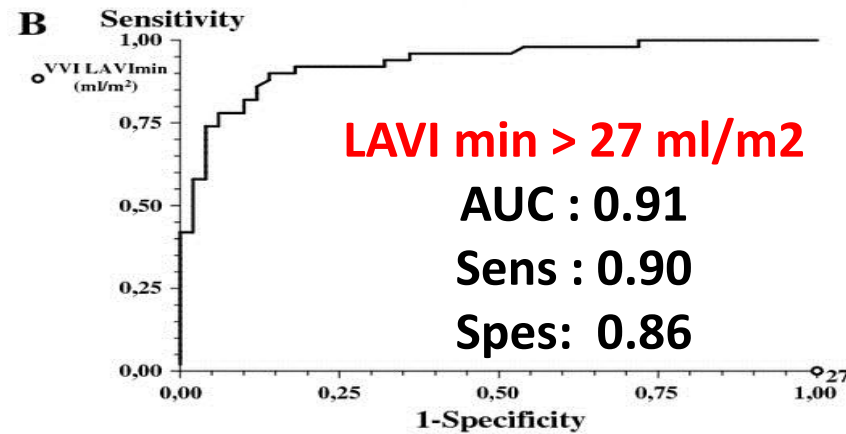
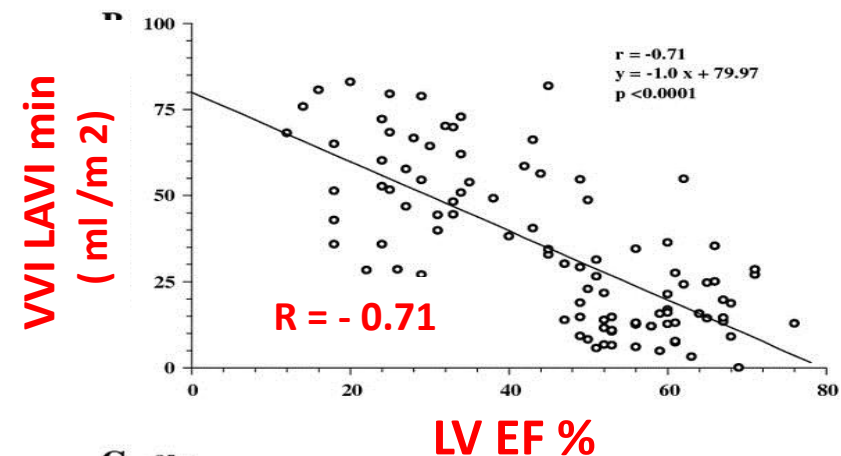
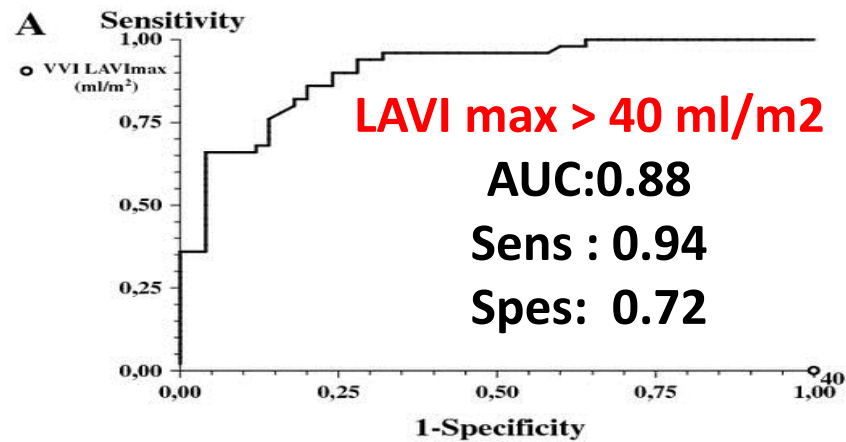
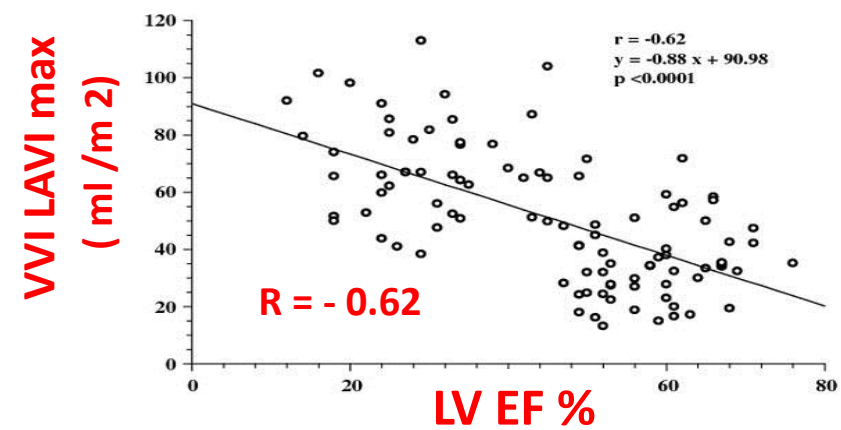
LA volümde her 10 ml artış BNP düzeyini 1.13 (1.02–1.26) kat arttırıyor ($p < 0.05$).

LA volüm BNP düzeyinin bağımsız belirleyicisi ($p < 0.0001$).

Global LA Longitudinal Strain ve BNP

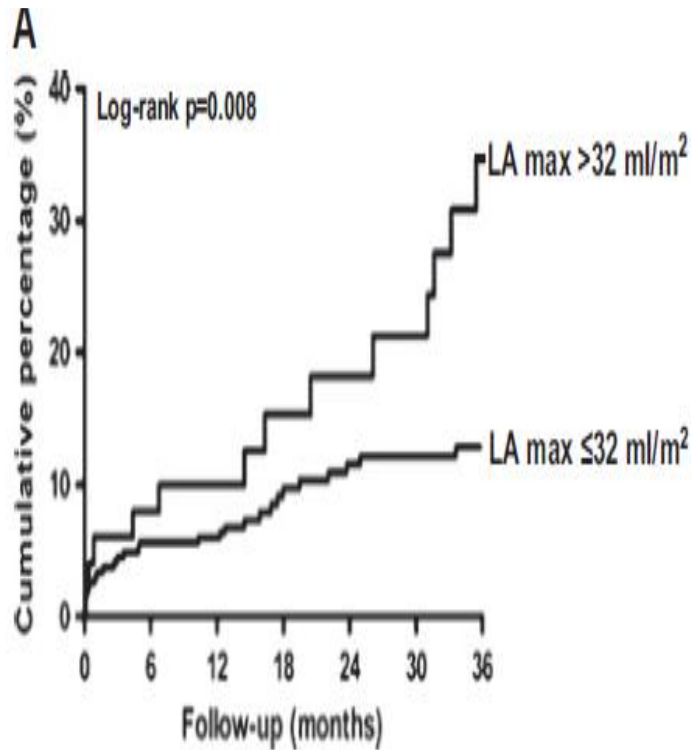




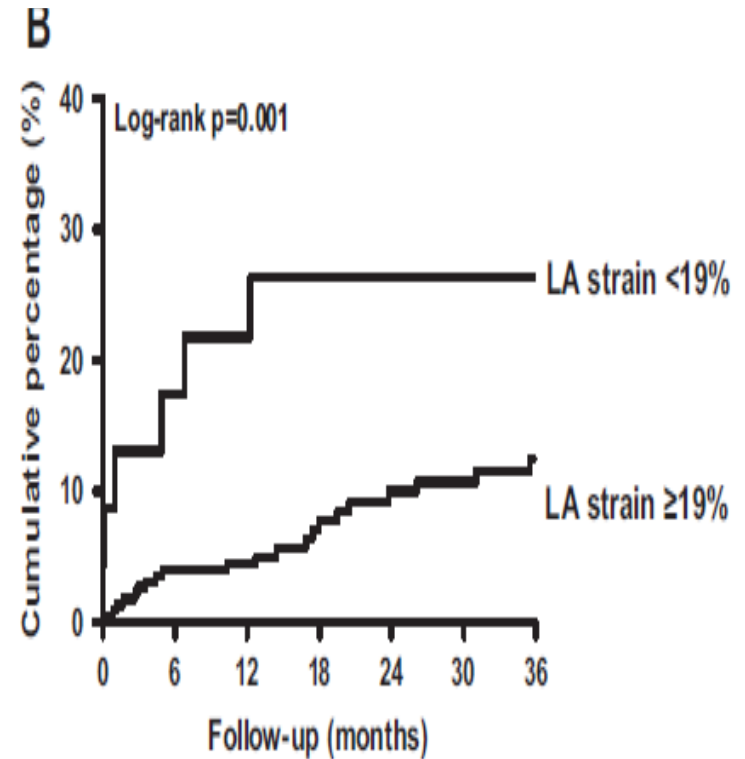


Primer PKG sonrası AMI seyrinde LA Volüm ve LA Strain

LA max volum (HR :1.05, CI 1.00-1.10, $p<0.04$) ve
LA strain (HR 0.94, CI 0.89 - 0.99, $p<0.02$) bağımsız belirleyici.



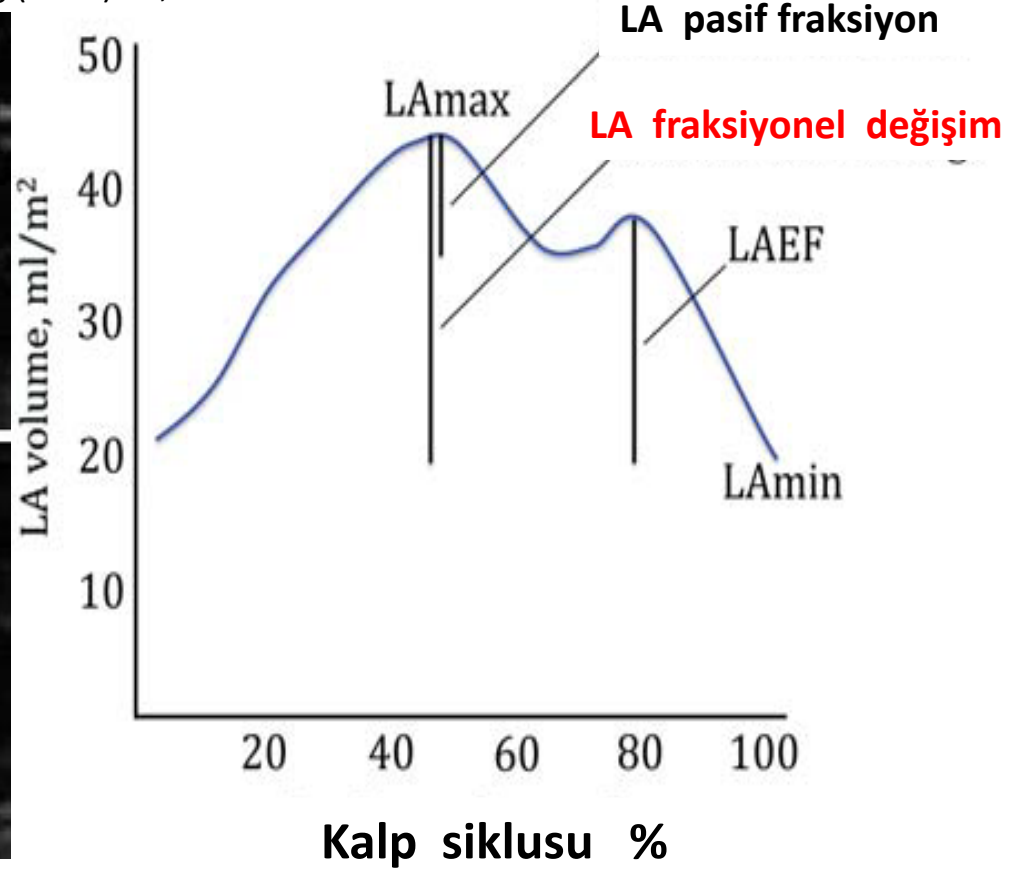
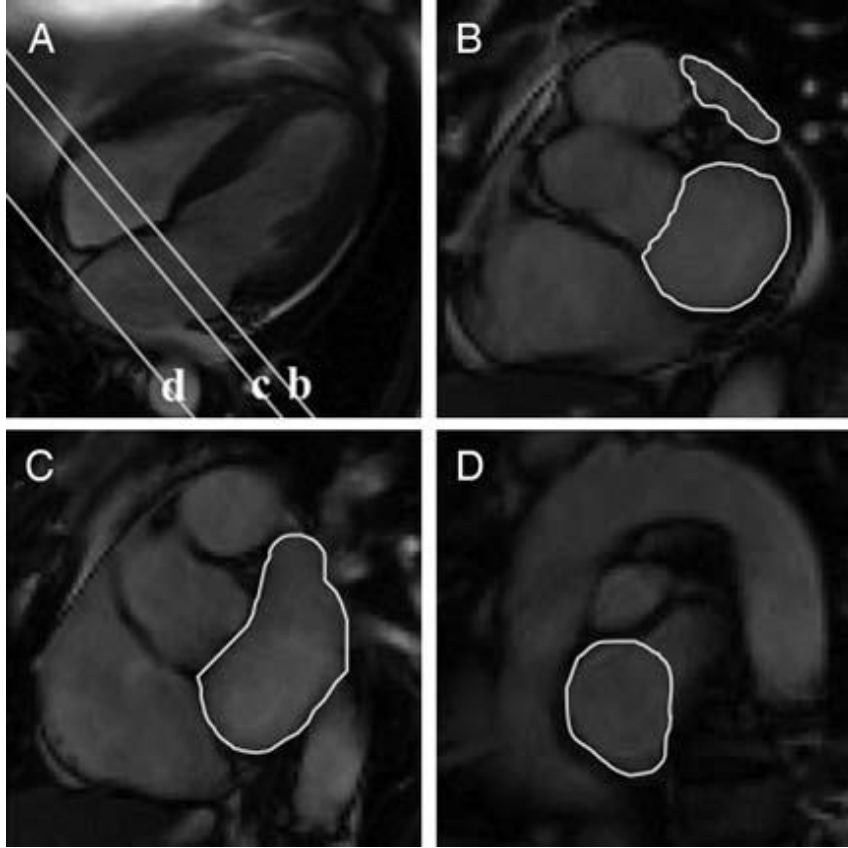
Patients at risk 318 296 172 129



Patients at risk 249 236 132 96

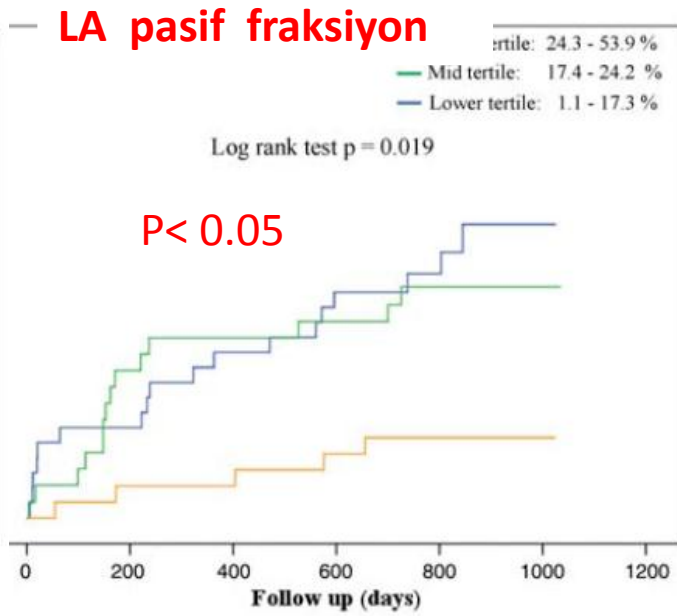
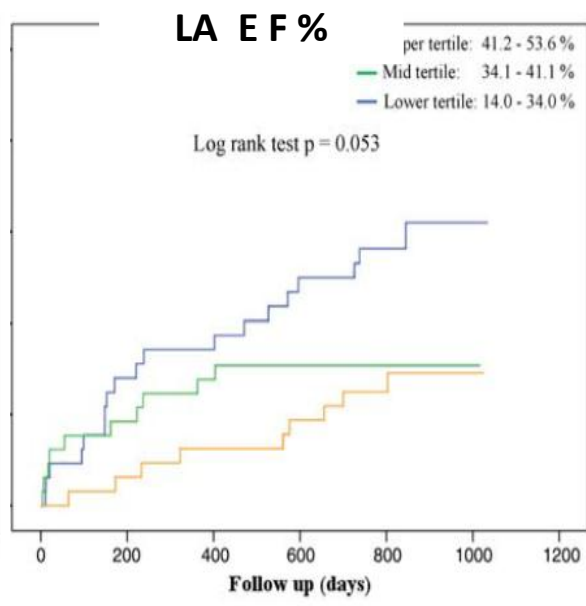
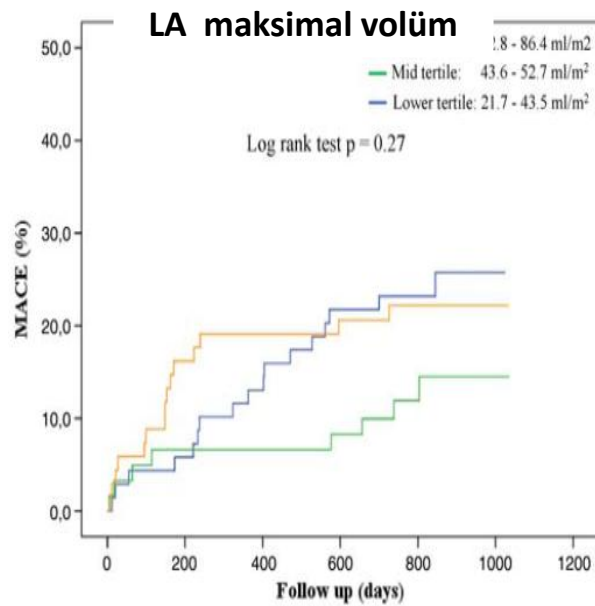
MRI ve STEMI sonrasında MACE LA fraksiyonel deęişim baęımsız belirleyici

Lonborg L, et al. Eur Heart J – Cardiovascular Imaging (2013) 14, 118–127

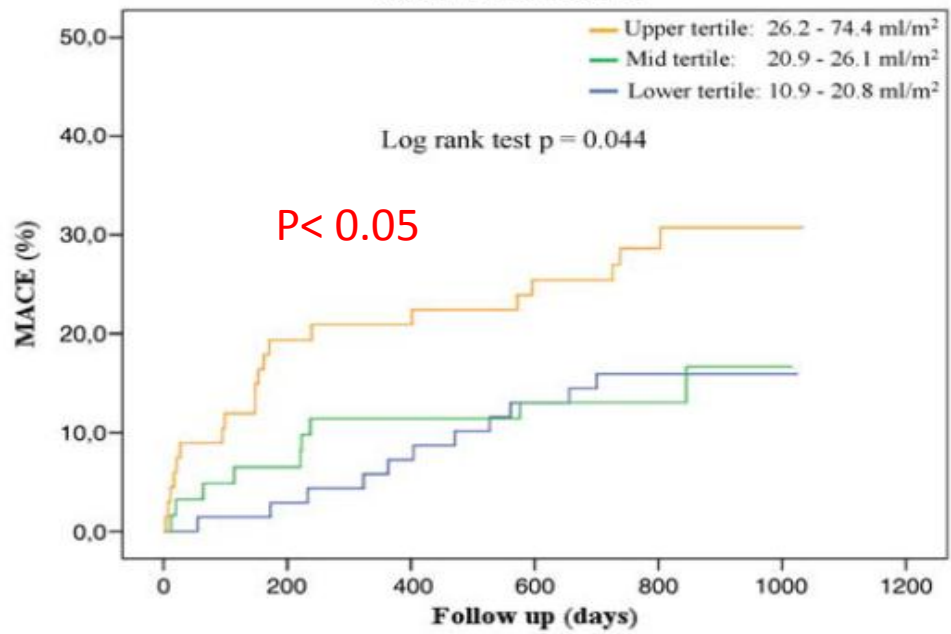


LA fraksiyonel deęişim MACE için baęımsız belirleyici

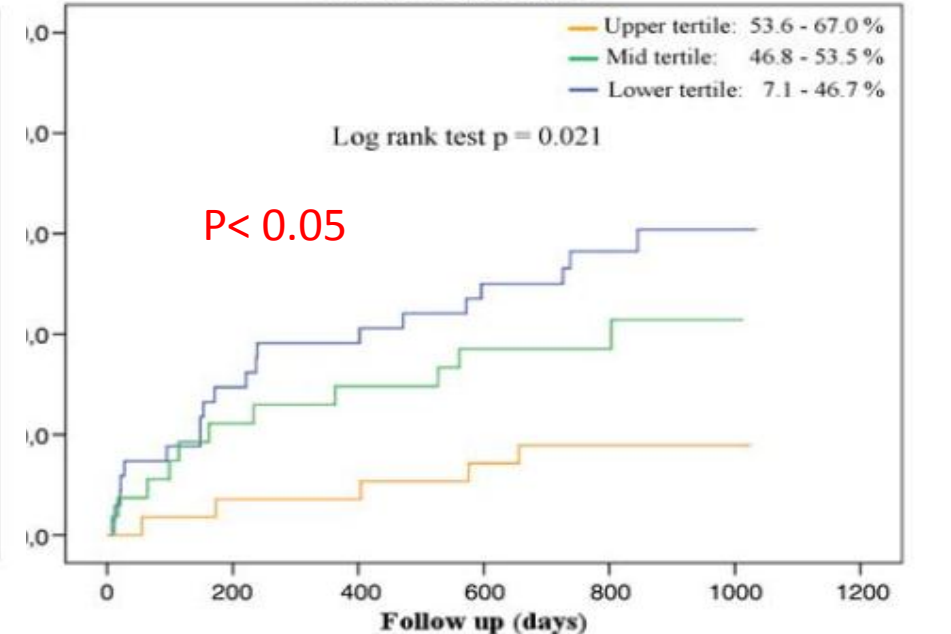
Düzeltilmiş HR: 0.66 (95% CI: 0.46–0.95)



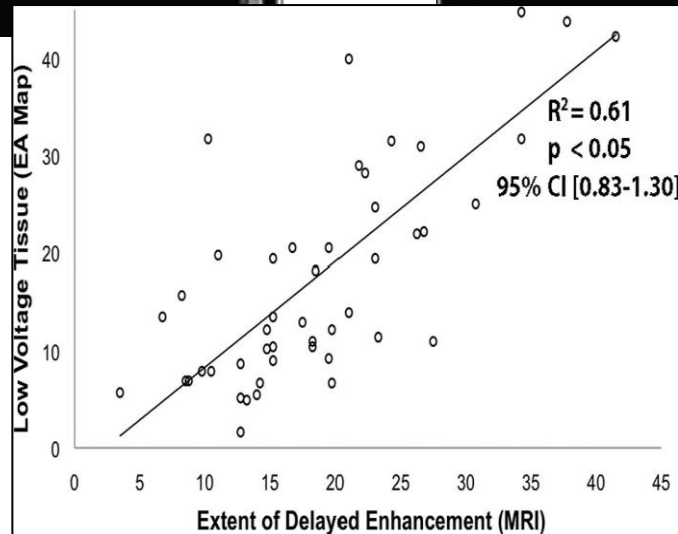
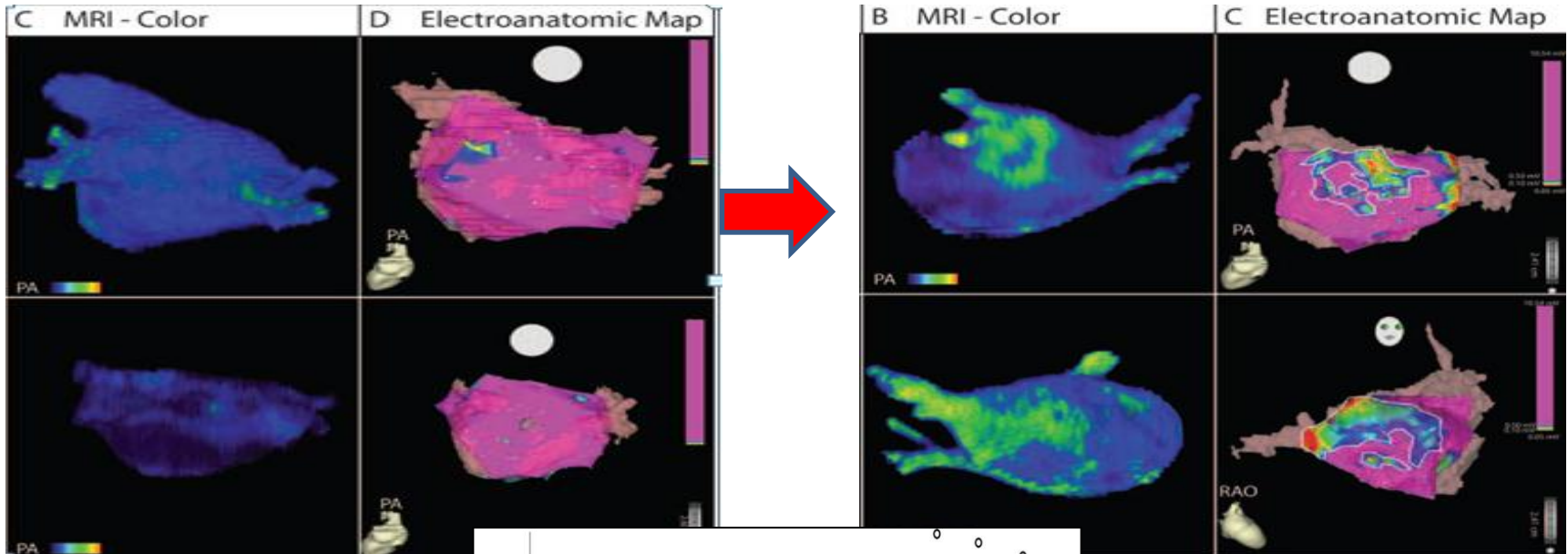
LA minimum volüm

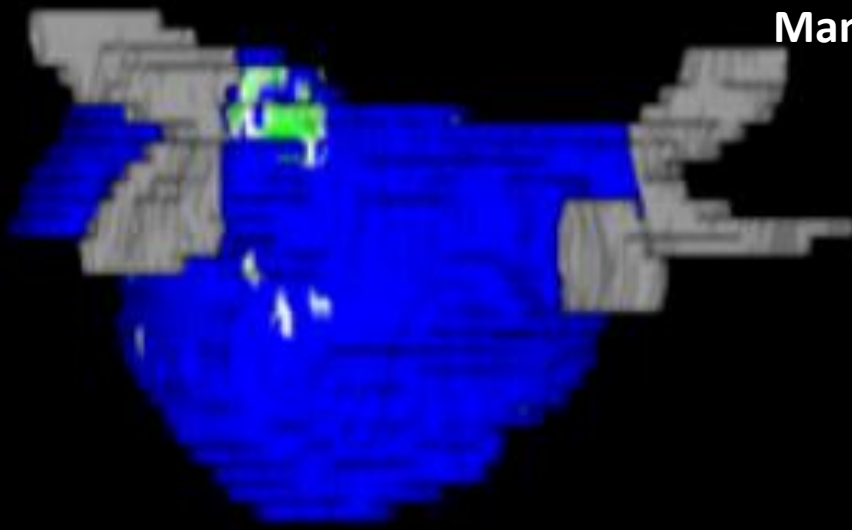


LA fraksiyonel değişim



3D delayed enhancement MRI ve LA Duvarında Düşük Voltaj

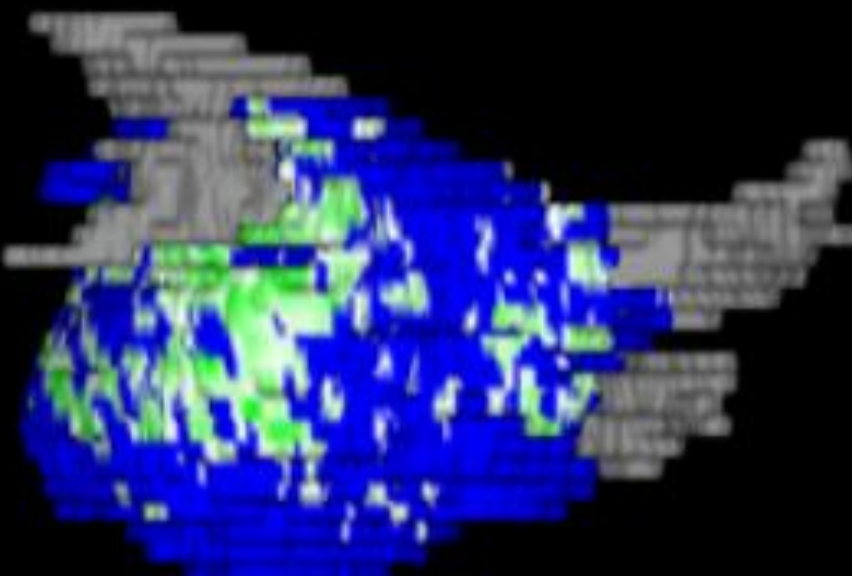




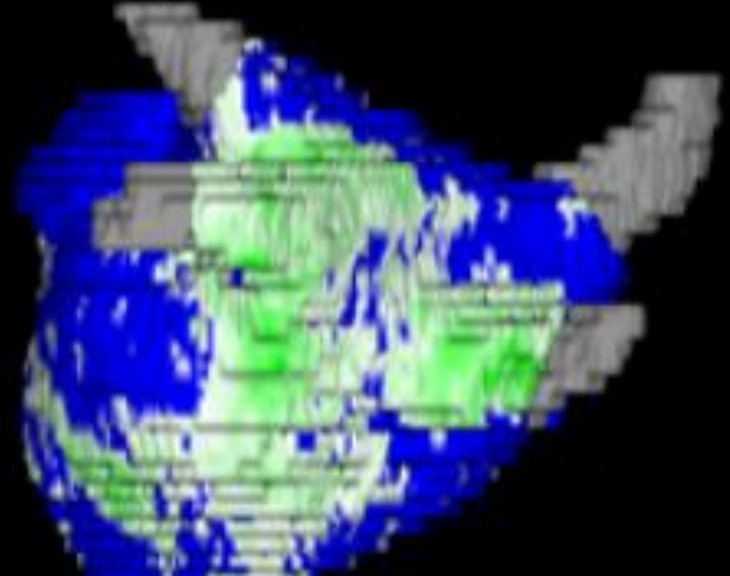
Utah I (DCE LA duvarinin $\leq 5\%$)



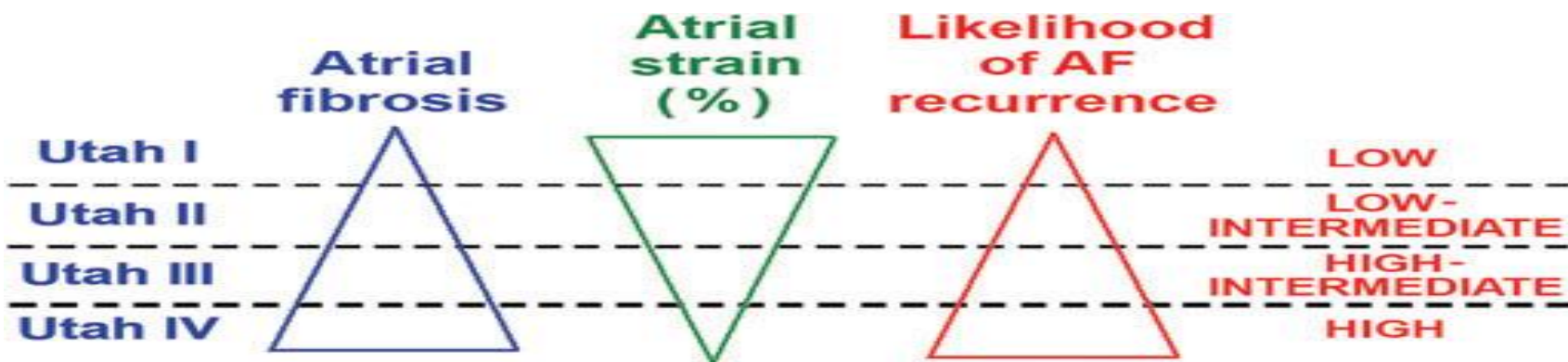
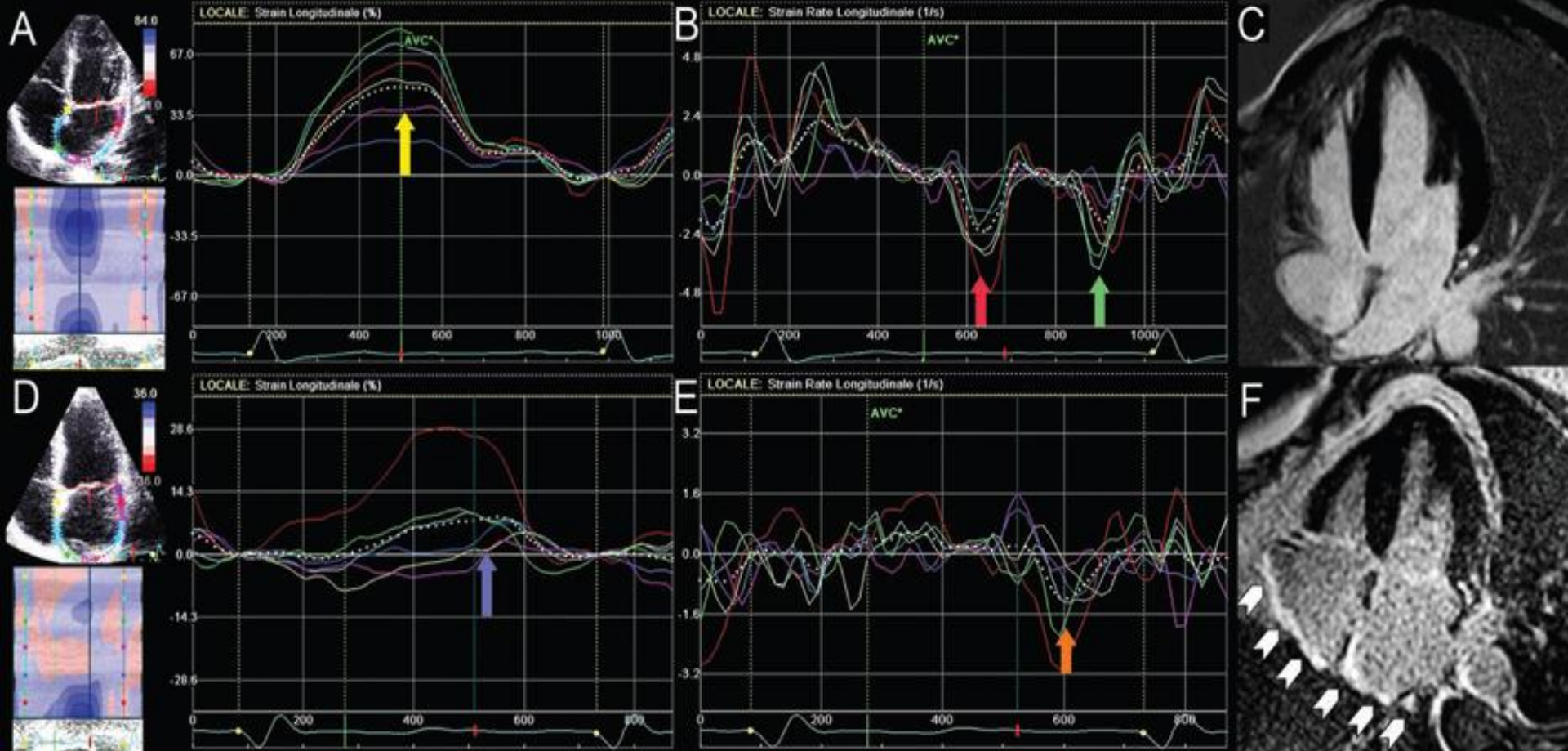
Utah II (DCE LA duvarinin 5 - 20%)



Utah III (DCE LA duvarinin 20-35%)

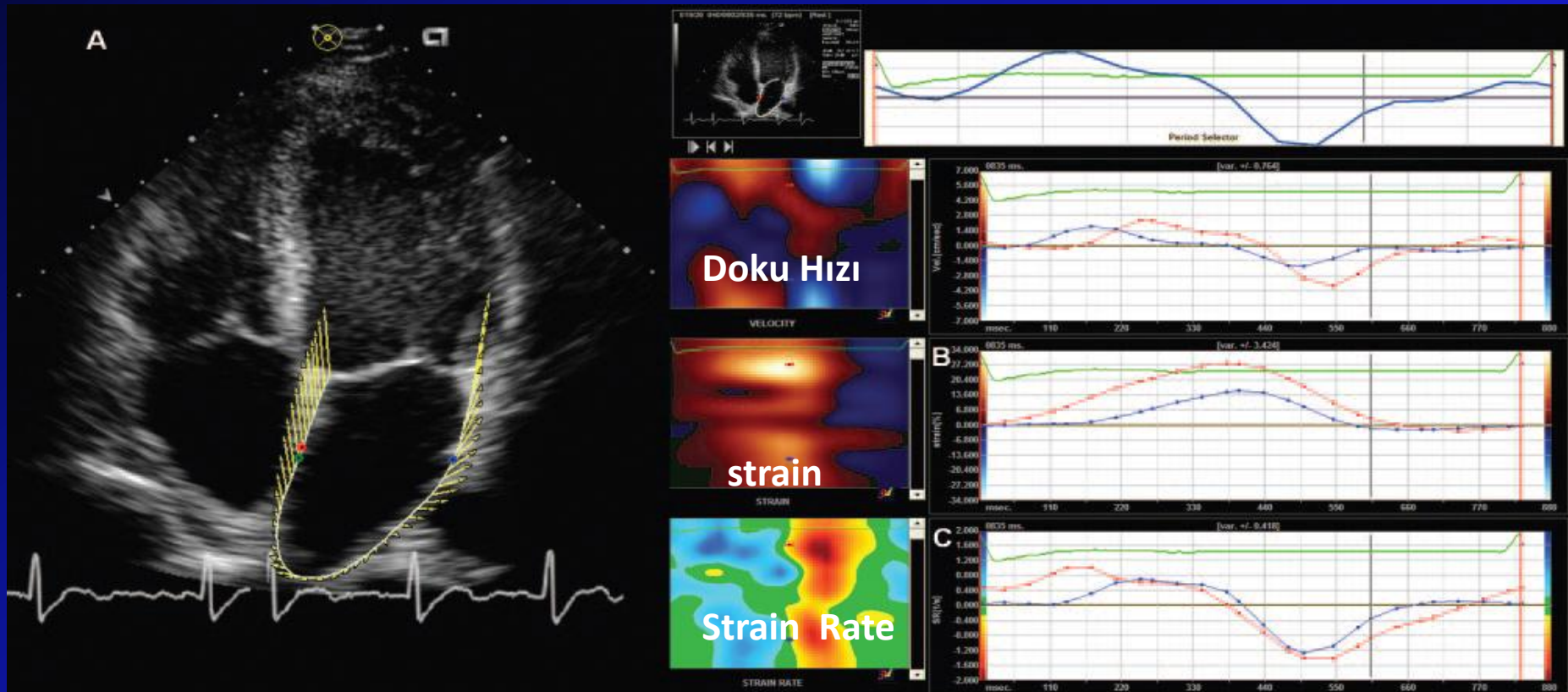


Utah IV (DCE LA duvarinin $> 35\%$)



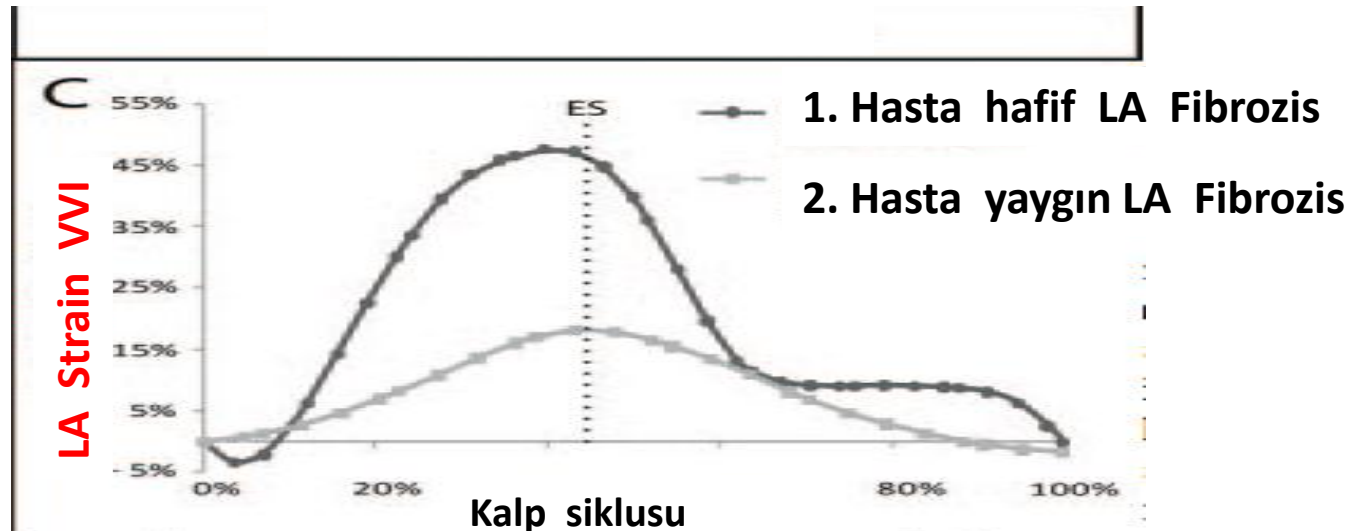
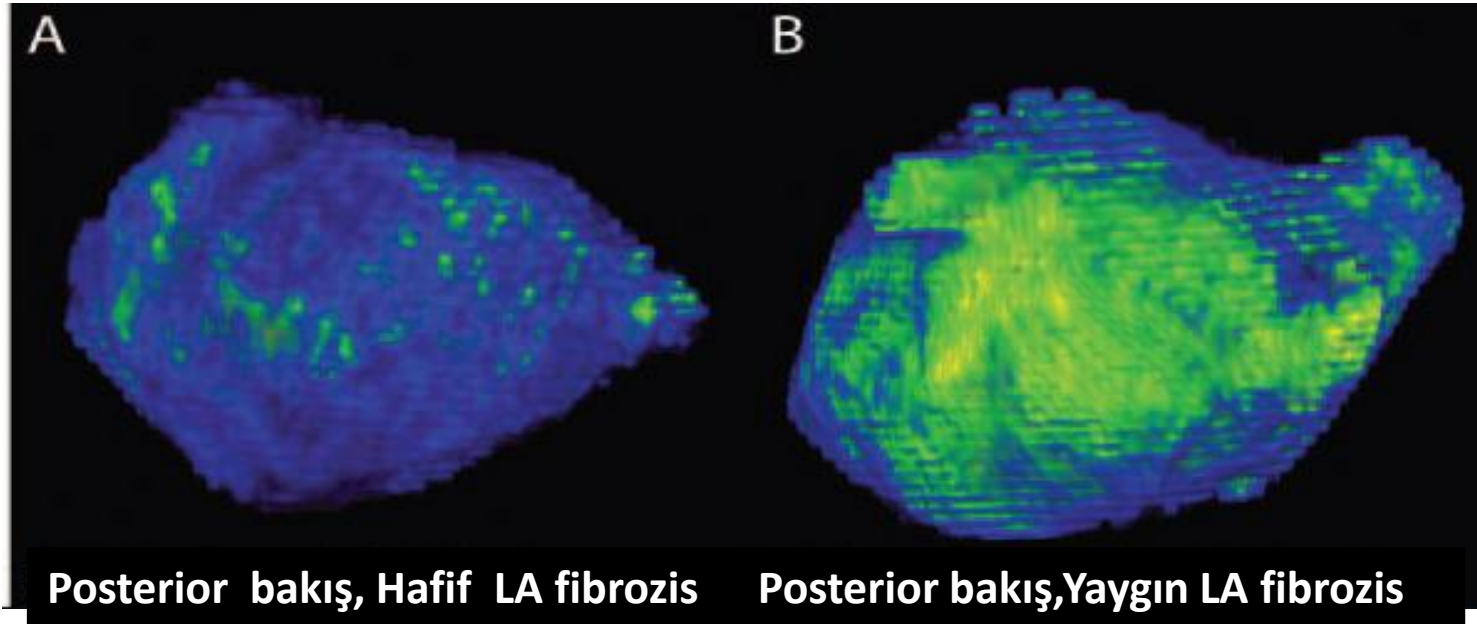
Longobardo L, et al. Eur Heart J– Cardiovascular Imaging (2014) 15, 1–5

VVI Eko ile Midlateral strain ($P=0.006$) ve strain rate ($P=0.01$) 3D DE MRI ile bulunan LA Fibrozunu bağımsız olarak öngörebilmiş.

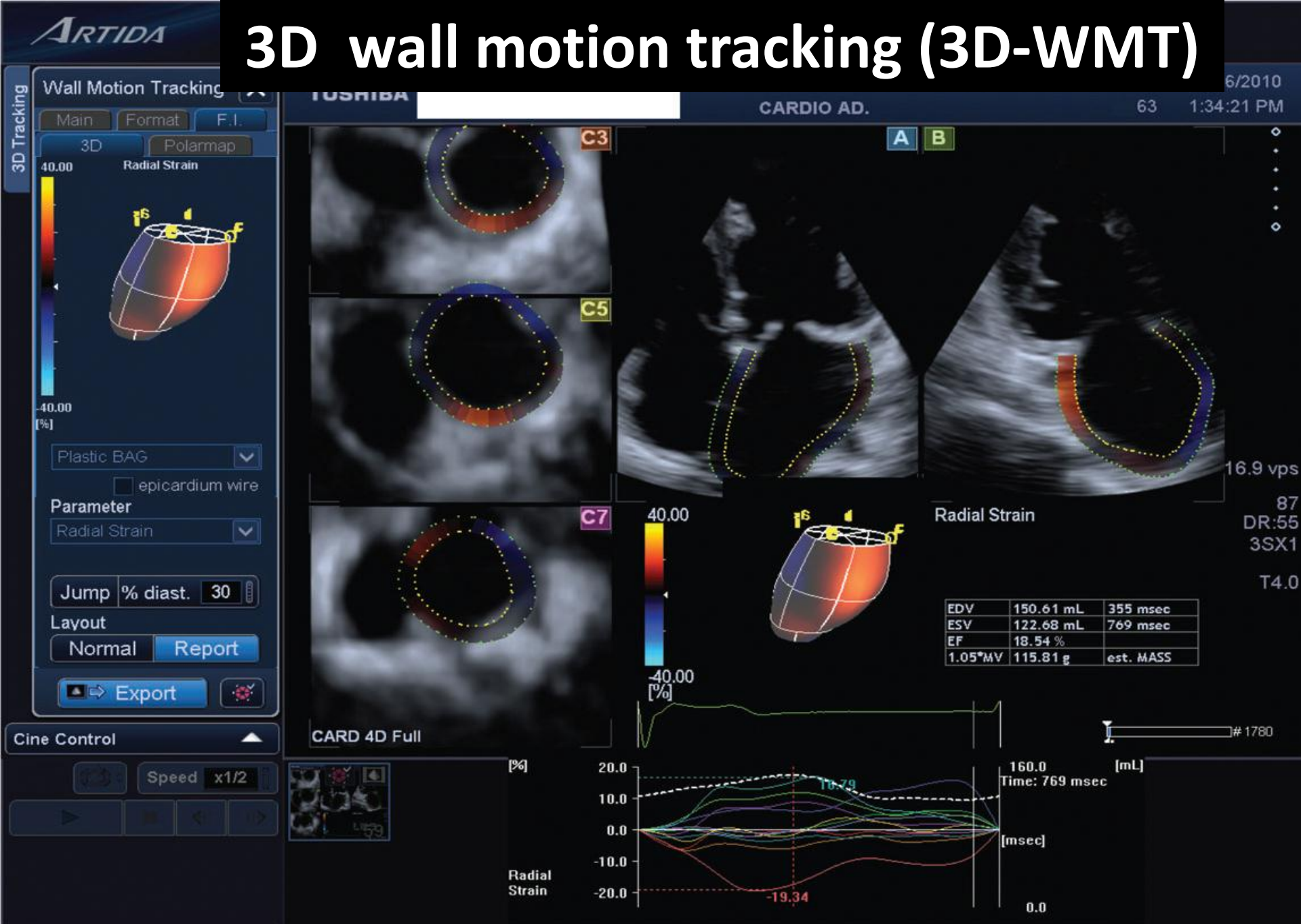


3D delayed-enhancement MRI vs VVI Eko LA Fibrozis ve LA Strain VVI

LA Fibrozis



3D wall motion tracking (3D-WMT)



CMRI Değerlerine kıyasla 2D Eko ve 3DWMT Uyumumu

| | r | p | ICC | % 95 CI |
|--------------------------------|-------------|-------------------|-------------|--------------------|
| 2D Eko LA Max Volum | 0.54 | < 0.001 | 0.60 | 0.43 – 0.73 |
| 3D WMT LA Max Volum | 0.83 | < 0.001 | 0.83 | 0.74 – 0.89 |
| 3D WMT LA Min Volum | 0.85 | < 0.001 | 0.85 | 0.77 – 0.90 |
| 3D WMT LA EF % | 0.82 | < 0.001 | 0.81 | 0.67 – 0.82 |

Son Sözlür I

- Sol Atriyumun anatomik ve işlevsel değeriendirilmesinde ekokardiyografi ; geleneksel 2D TTE ve TEE ' den güncel 3D volüm, Strain ve Strain Rate ölçüm yöntemlerine dek süren yeni seçenekler sunabilmektedir.

Volüm değeriendirilmesinde real time 3D, deformasyon değeriendirilmesinde 2D ve Doku Doppler Strain ve SR kalp MRI ile uyumlu sonuçlar ortaya koyabilmektedir.

Son Sözler II

- RT3D ve Strain/SR ekokardiyografi ile ortaya konulan LA deęerleri AF, mitral kapak hastalıkları ve iskemik kalp hastalığında klinik seyri öngörebilmektedir.
- Söz konusu yöntemler, AF riski ve PVA sonrası AF nüksünü hazırlayan fibrotik deęişimleri de öngörebilmektedir.