

# Real-Time Imaging



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I have no financial interests or relationships to disclose with regard to the subject matter of this presentation.



# Key Features of Real-Time MRI

- **Resolves Physiology** (including irregular movement)
  - Speed, Resolution, Contrast
- **Provides Interaction**
  - Low end-to-end latency (~200 to 400ms)
- **Task Specific**
  - Physiological Monitoring, Tool Visualization

Workflow

90 min → 45 min

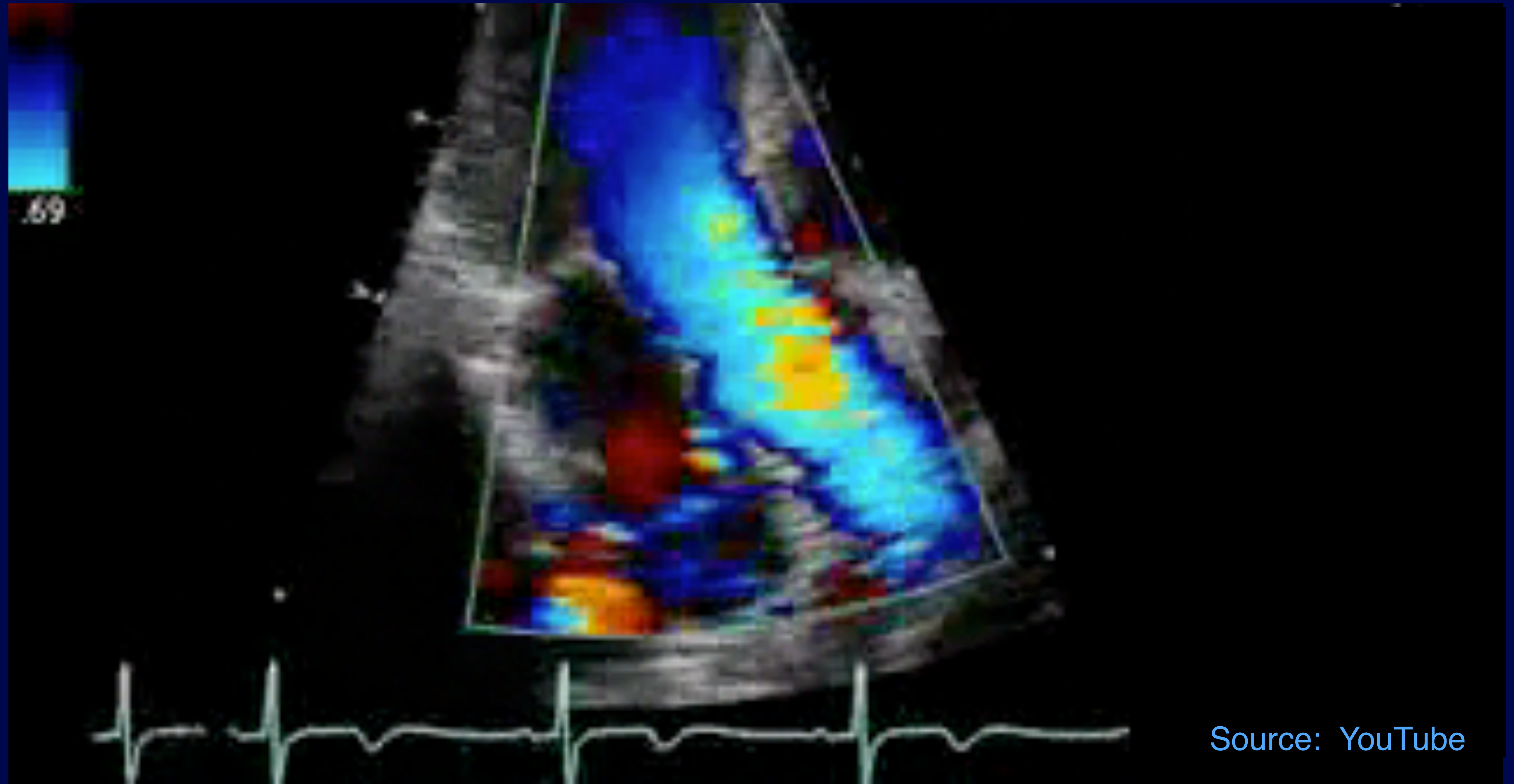


Physiologic  
Stress

Challenging

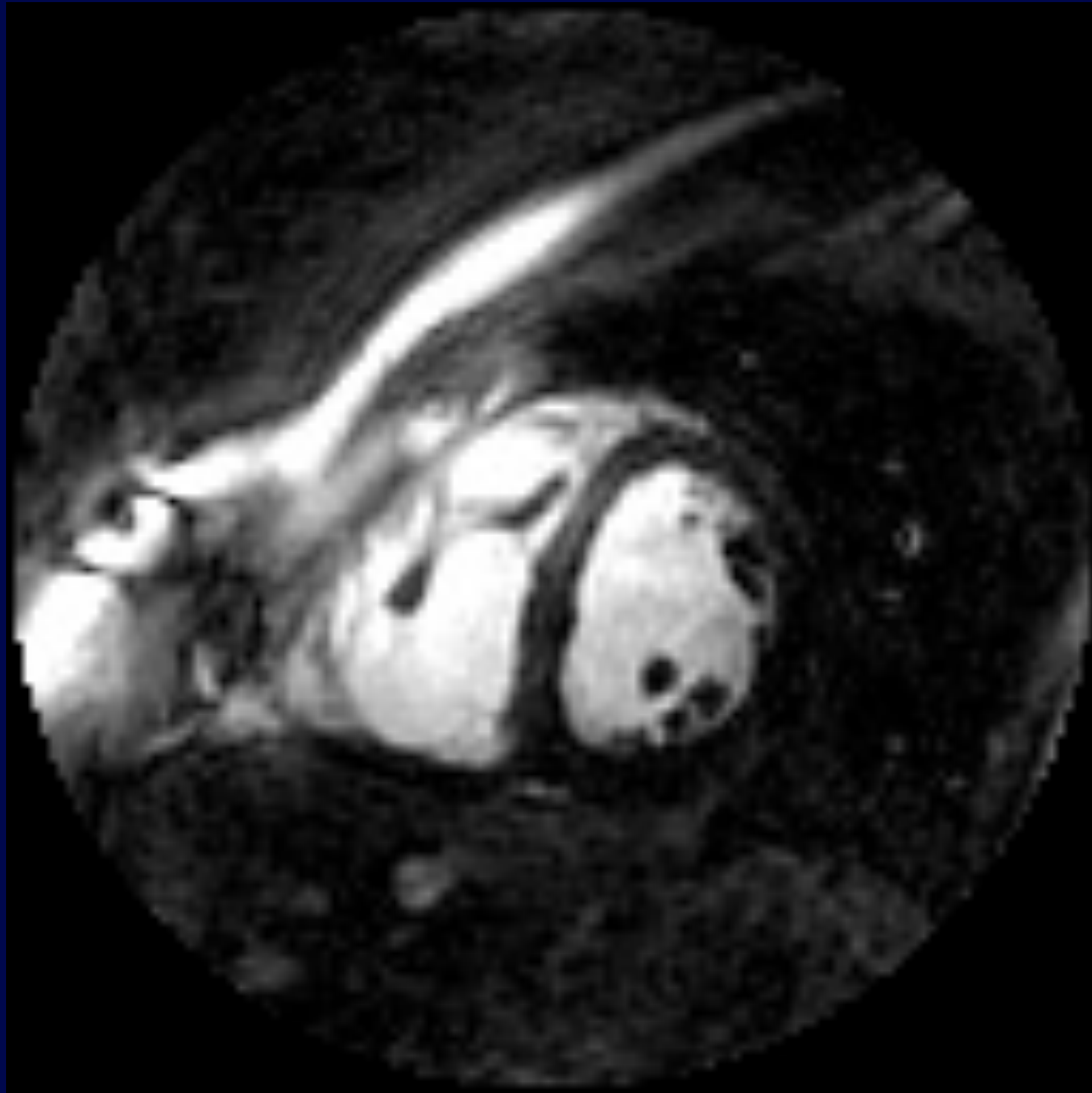
Patients ~20%

# Echocardiography

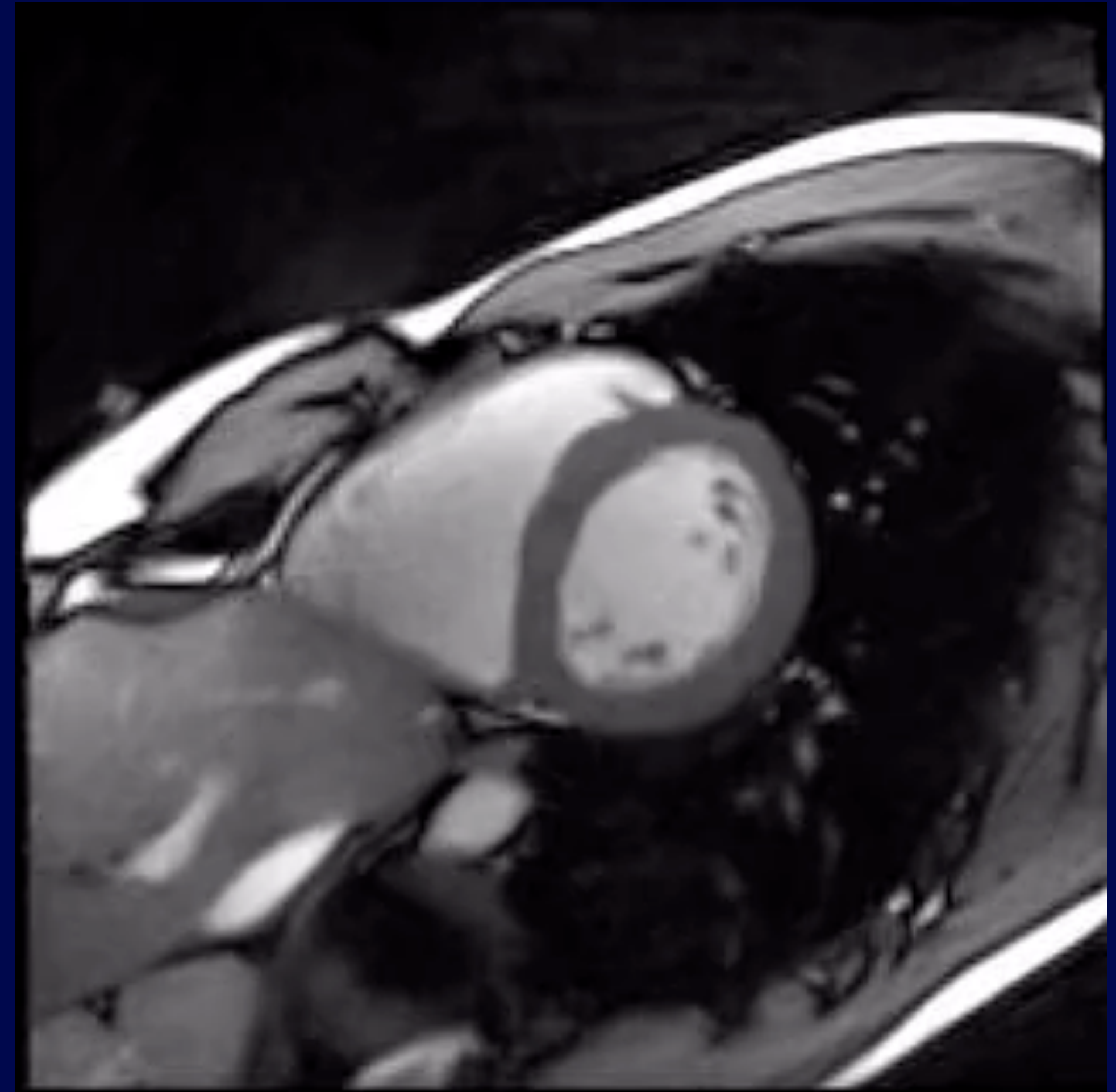


Source: YouTube

# LV Function (Image Quality)

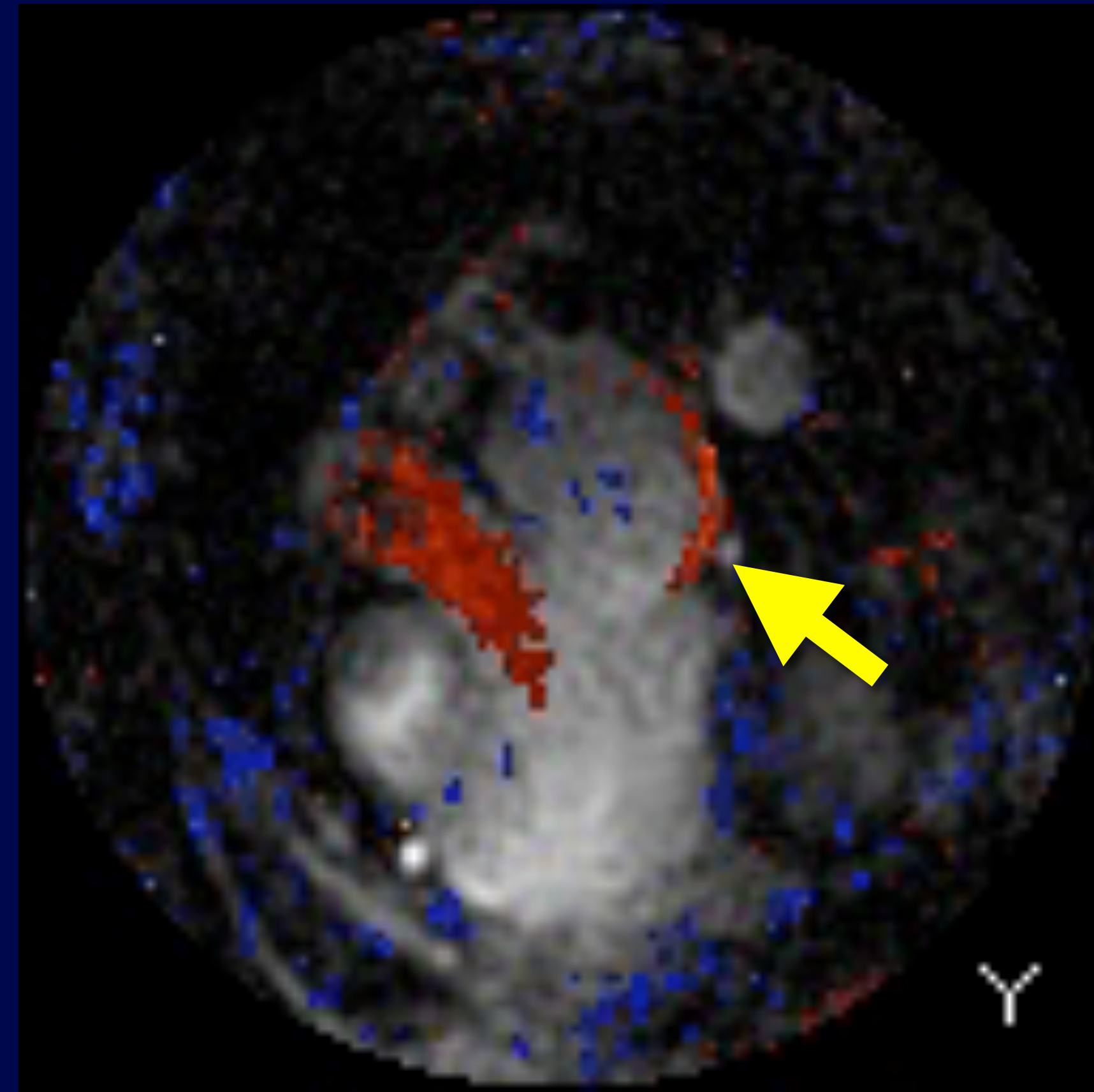
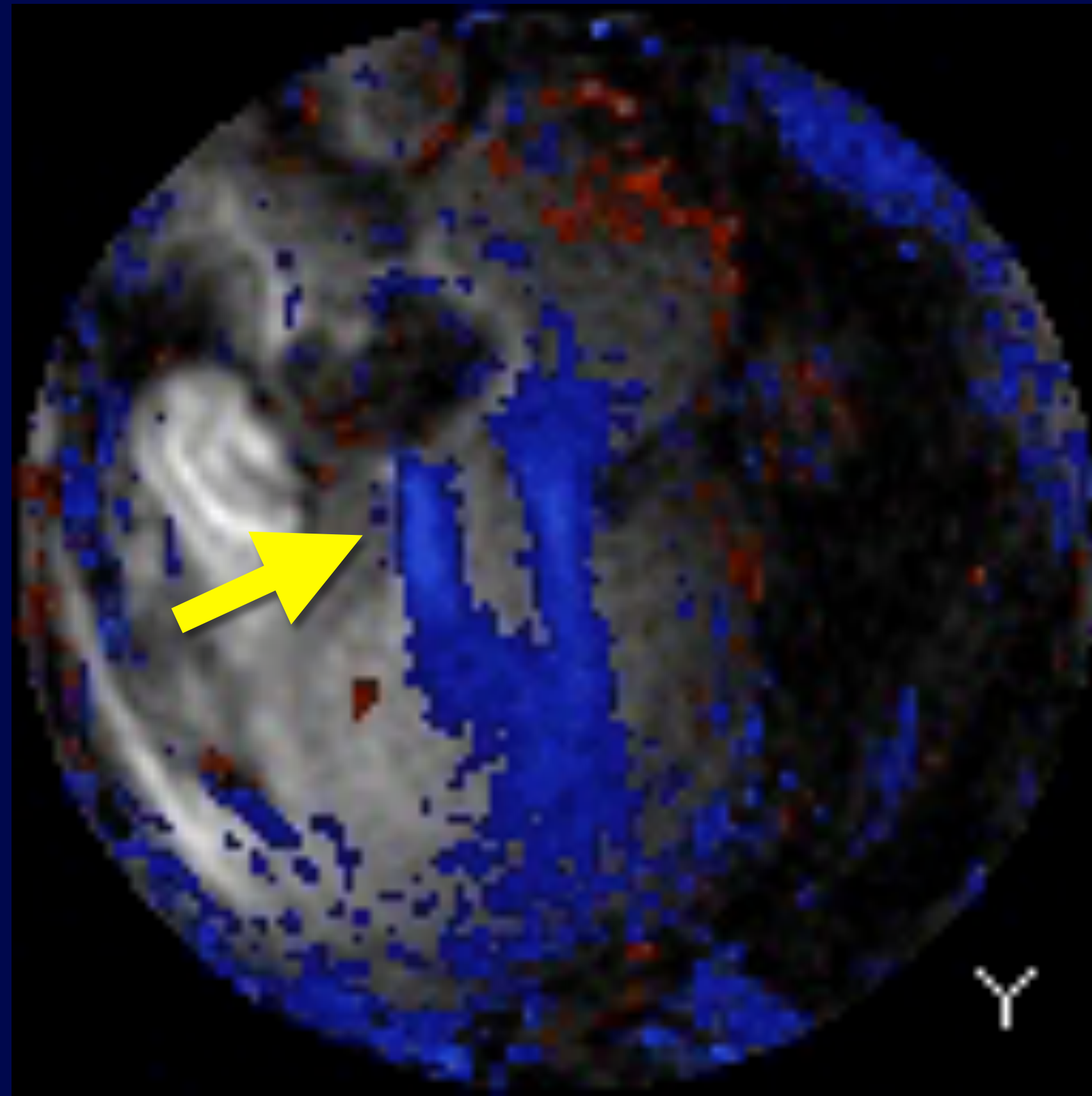


[2001] 1.5T Spiral SSFP  
KS Nayak et al., MRM 53:1468-1473



[2015] 3T Radial SSFP + Constraint  
Source: Max Plank BiomedNMR

# Valve Assessment

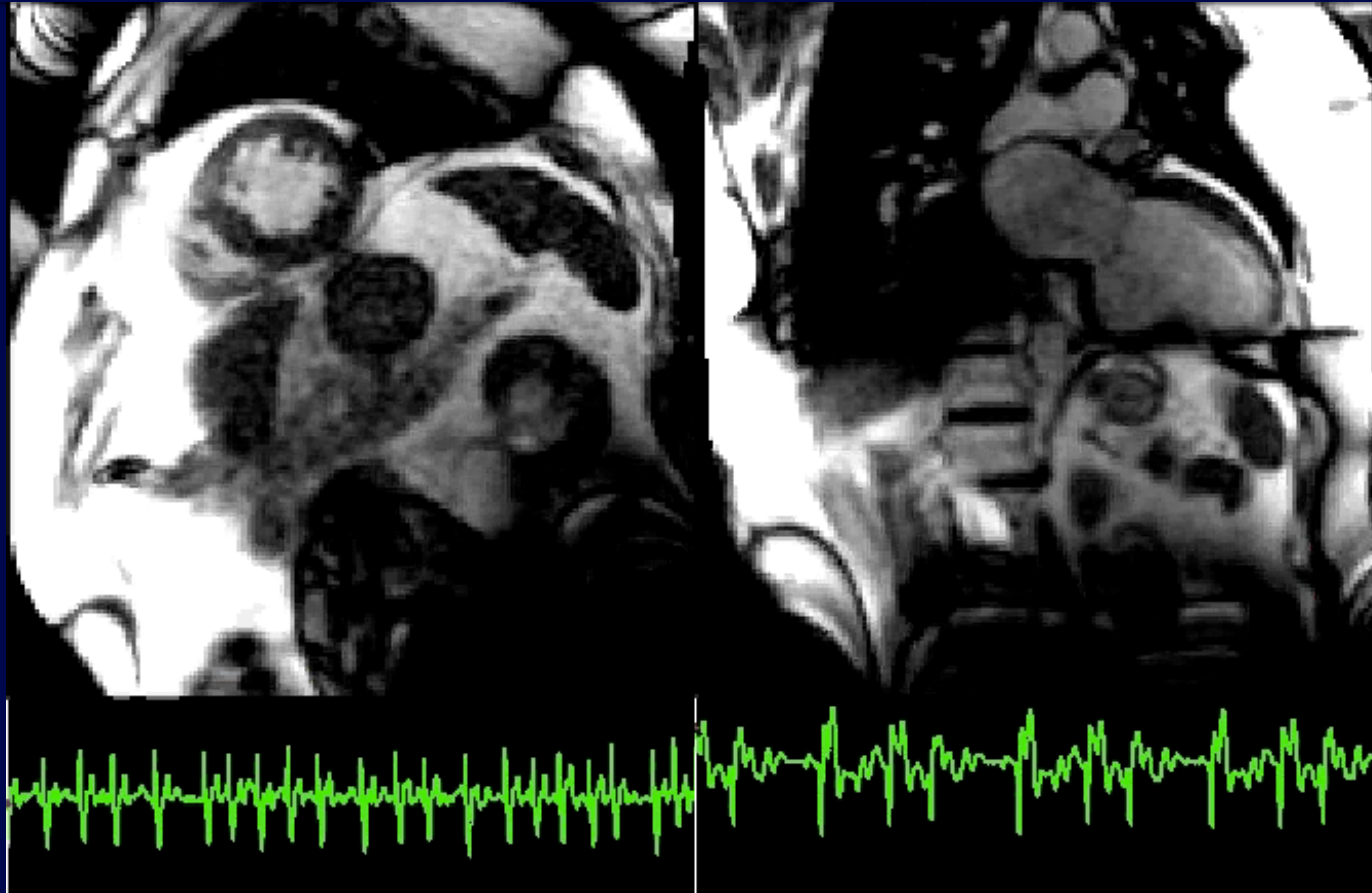


>85% detection of clinically significant disease  
>90% agreement with echo within one grade

KS Nayak et al., MRM 43:251-258  
PA Rivas et al.



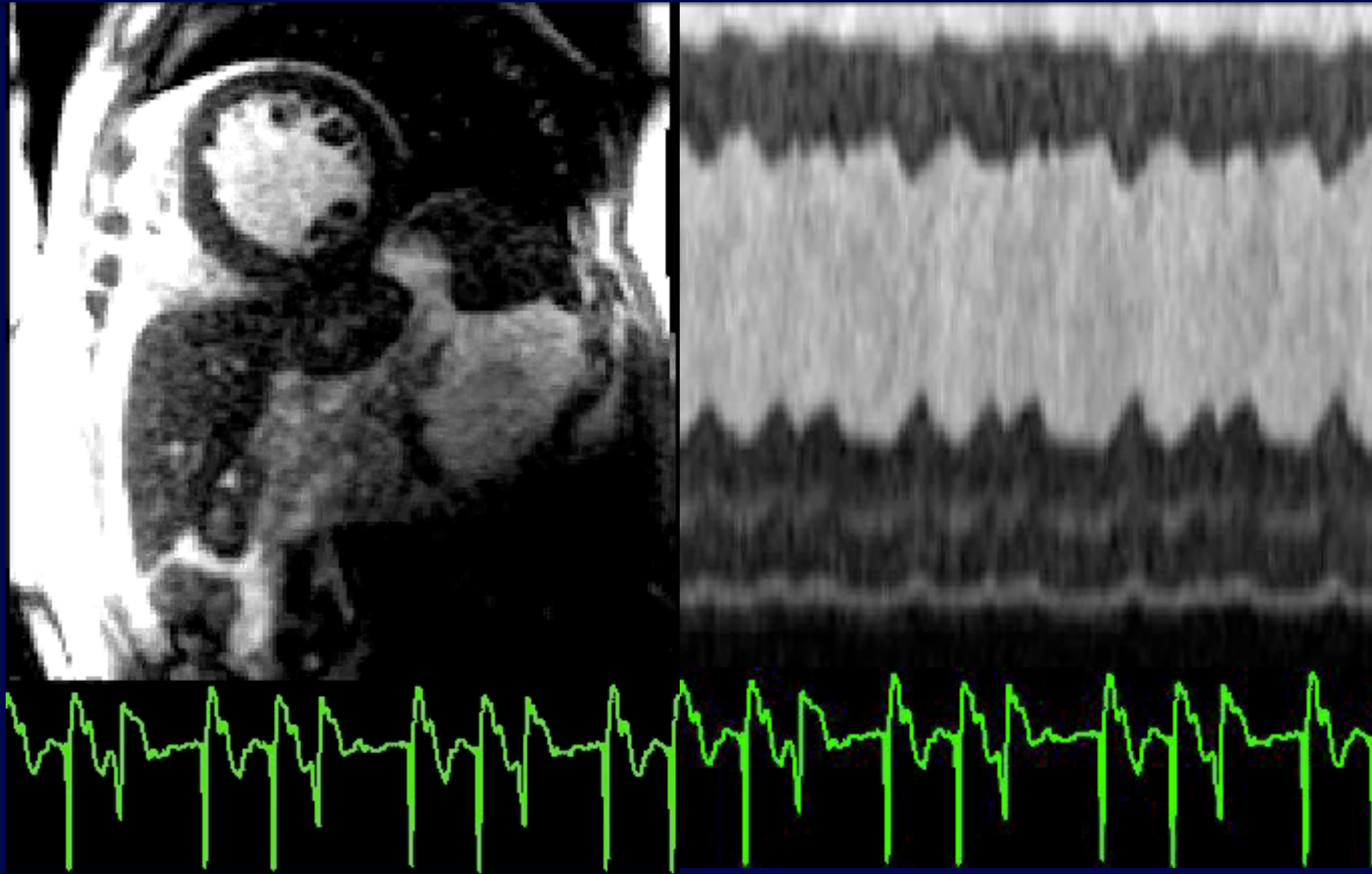
# Atrial Fibrillation



Diagnostic  
Real-Time

Source:  
P Kellman (NIH)

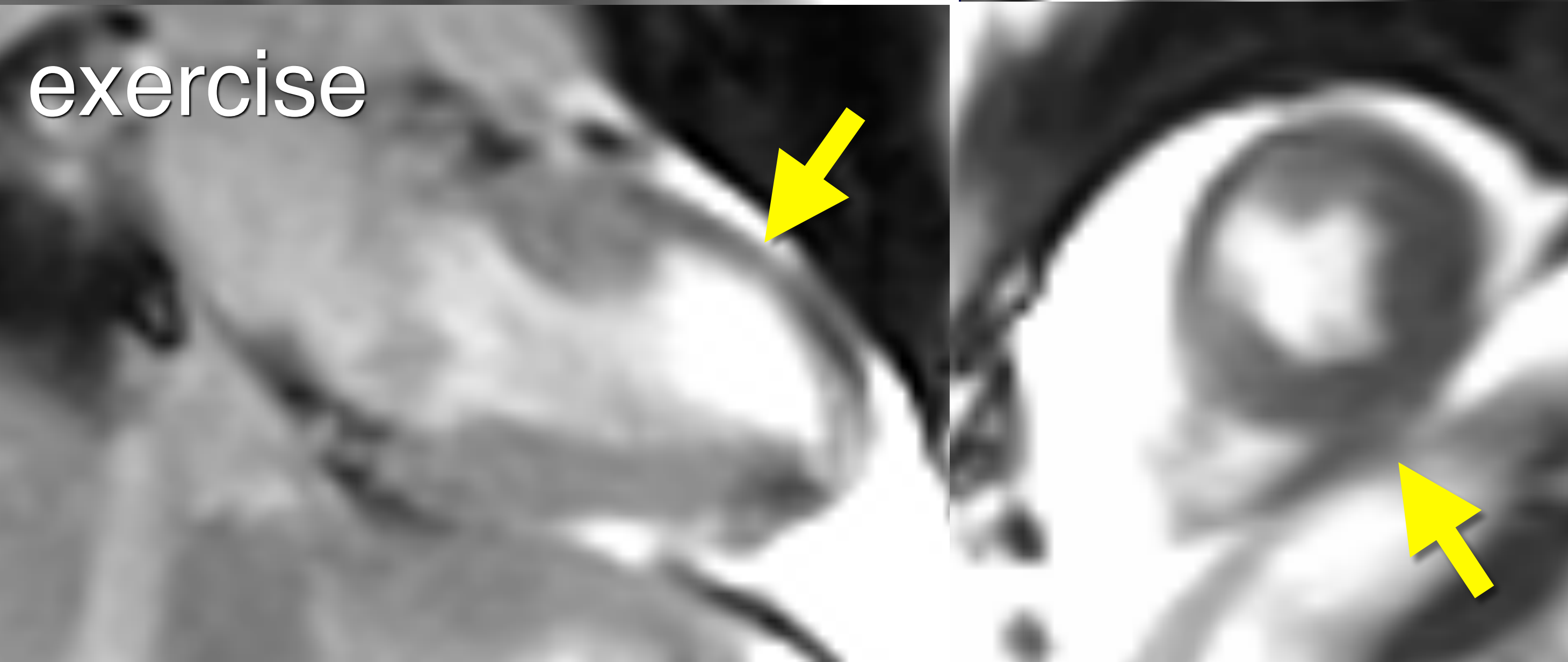
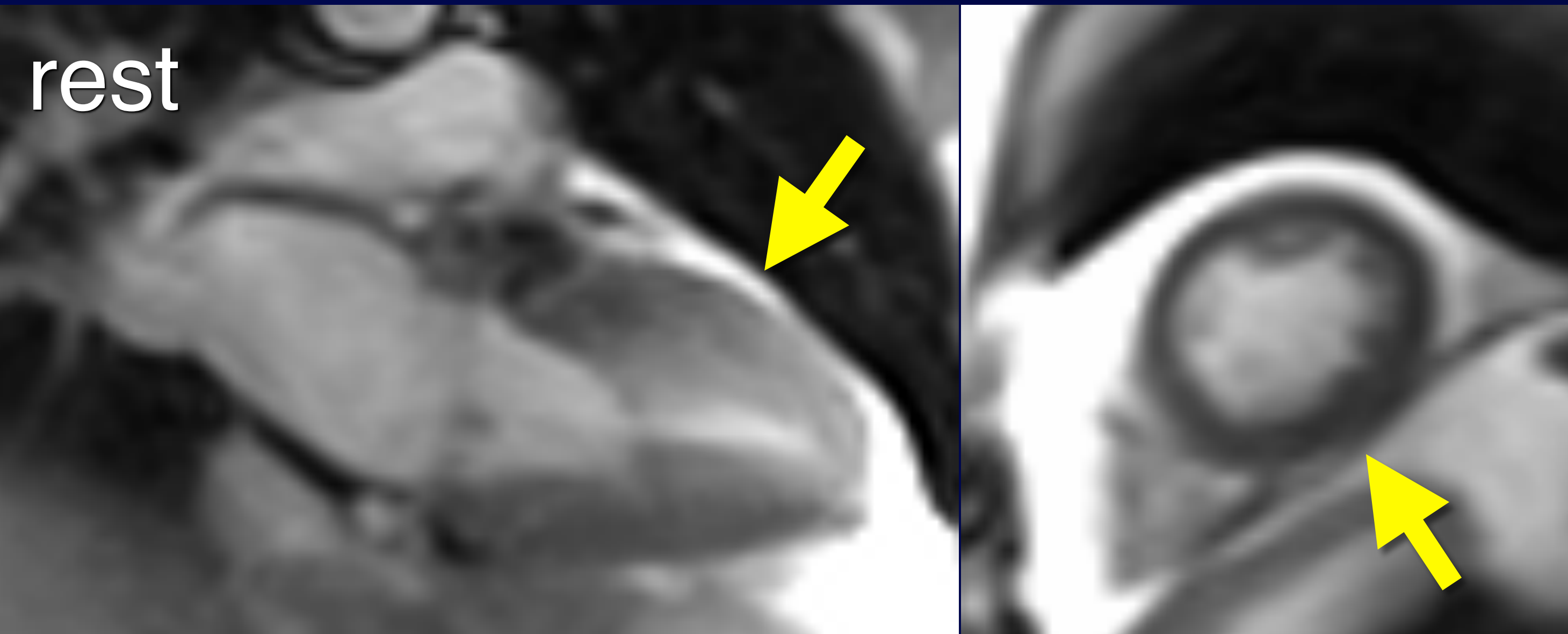
# Atrial Fibrillation



Diagnostic  
Real-Time

Source:  
P Kellman (NIH)

# Exercise Stress Testing

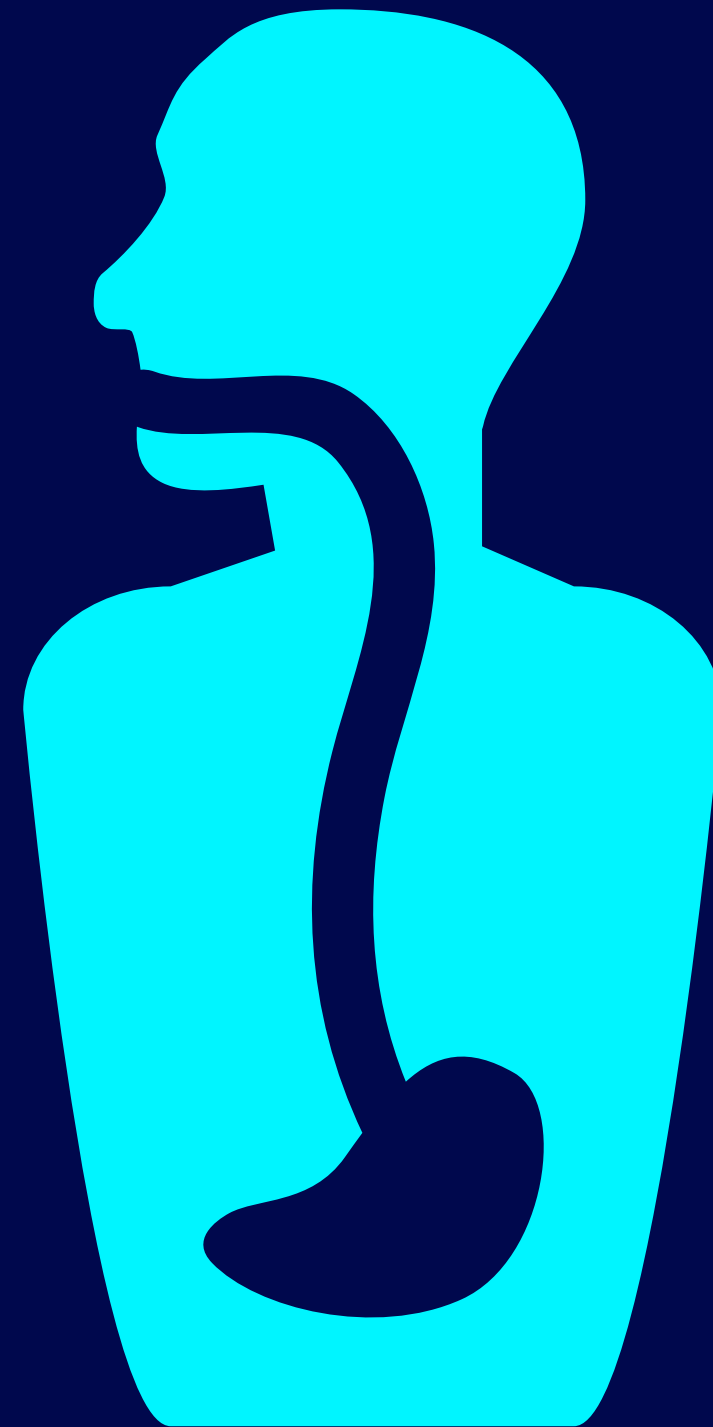


EXACT Trial

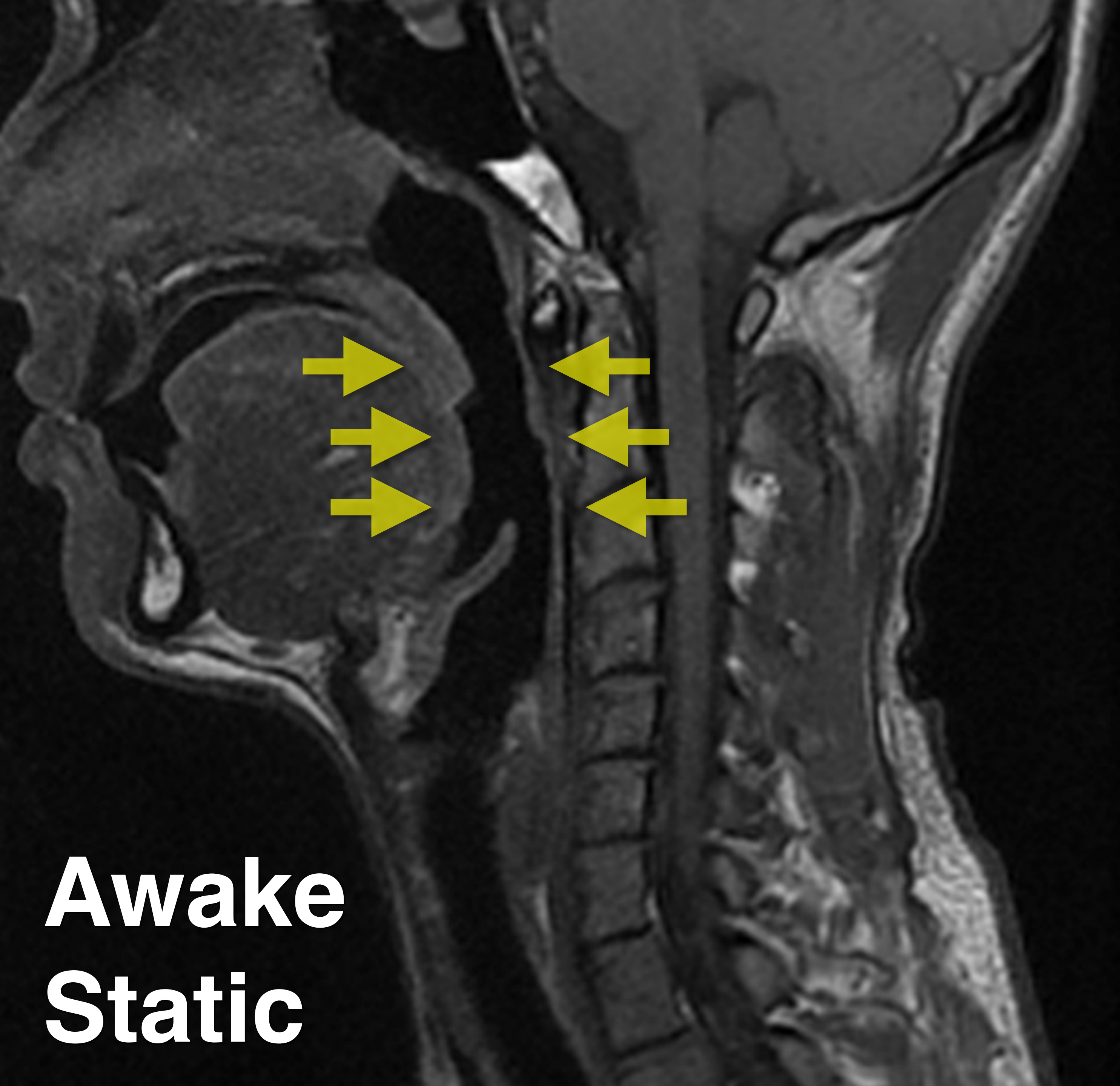
RT-MRI detects  
abnormal wall motion  
during exercise stress

SV Raman, O Simonetti, et al.  
JAHA 2016 19;5(8)

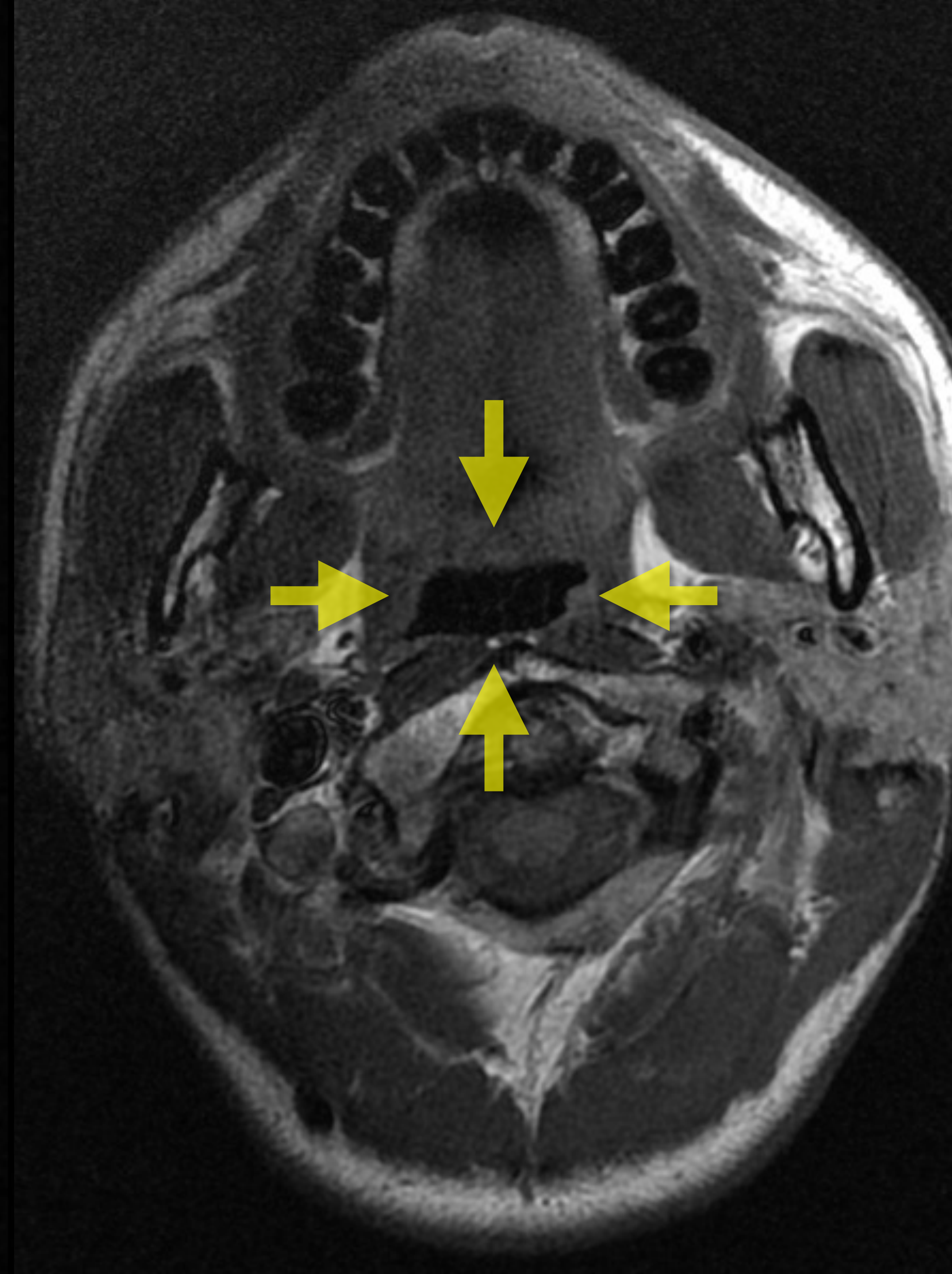
Sleep-Related  
Breathing



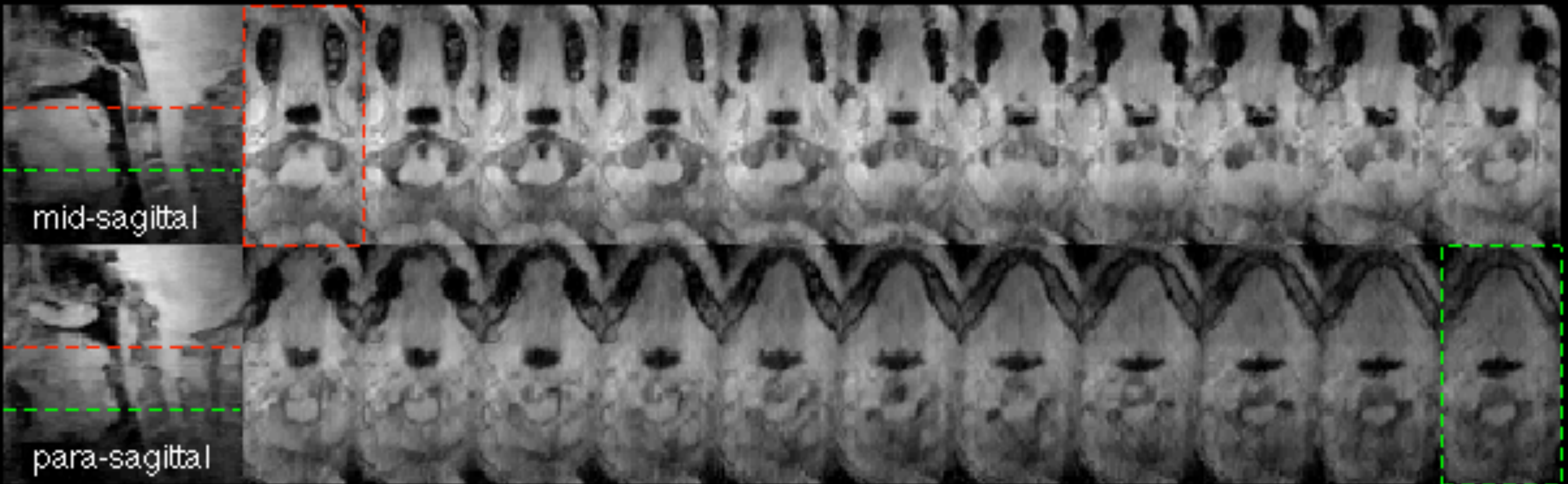
Speech  
Production



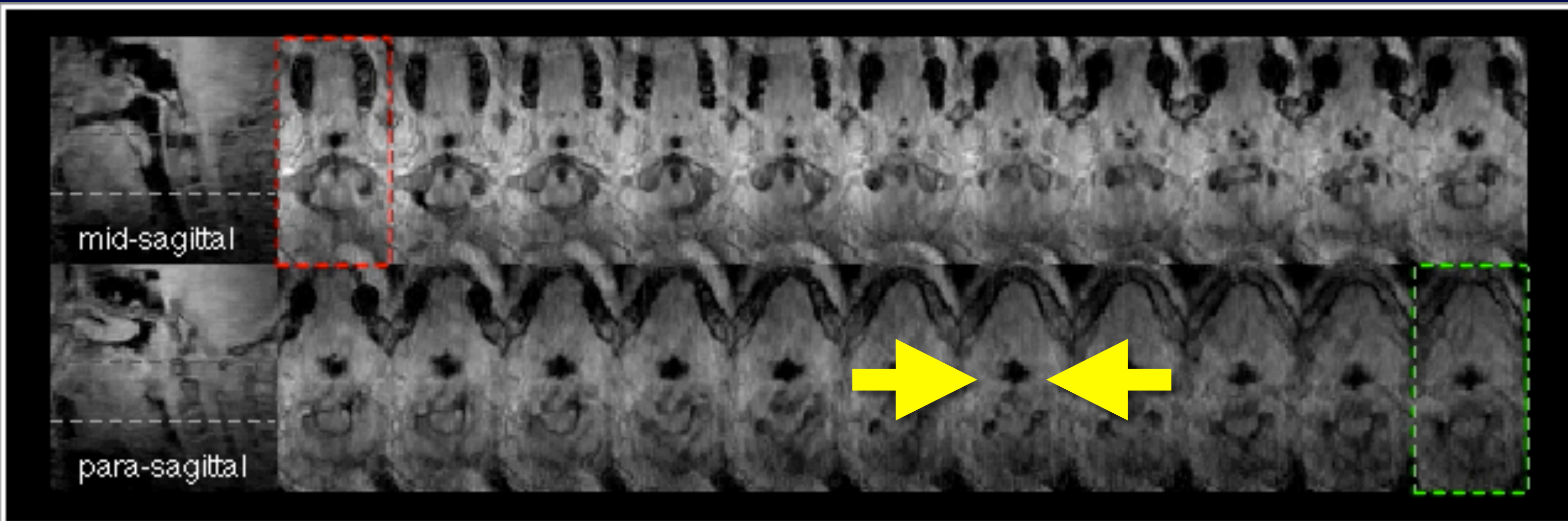
**Awake  
Static**



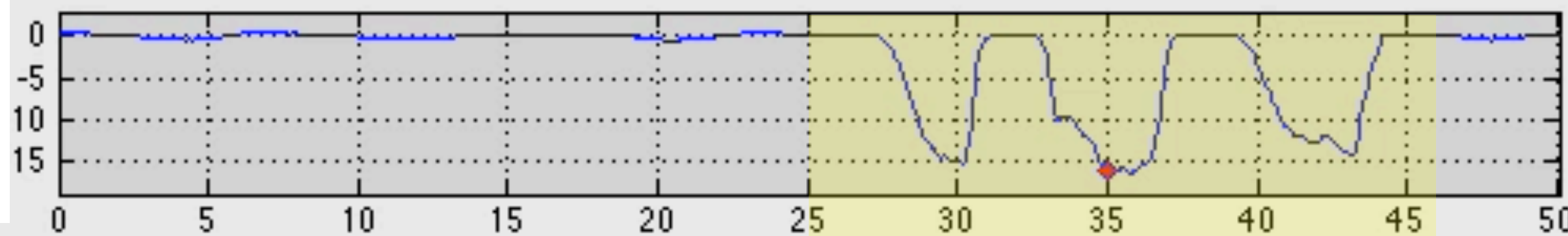
# Dynamic with Inspiratory Load



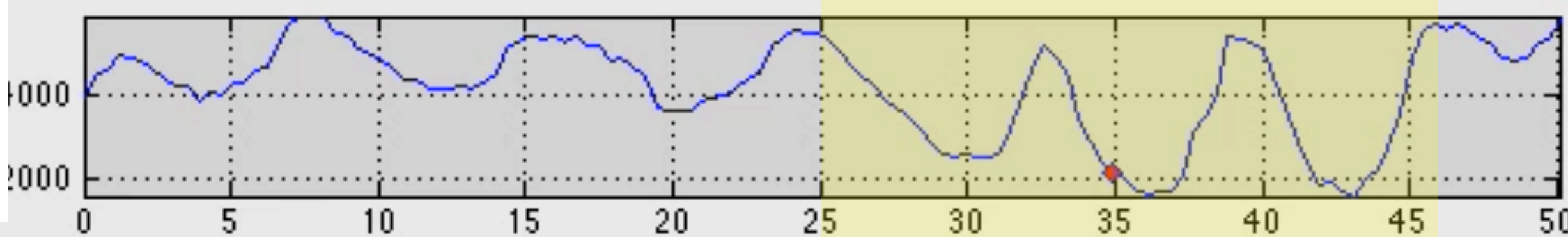
# Dynamic with Inspiratory Load



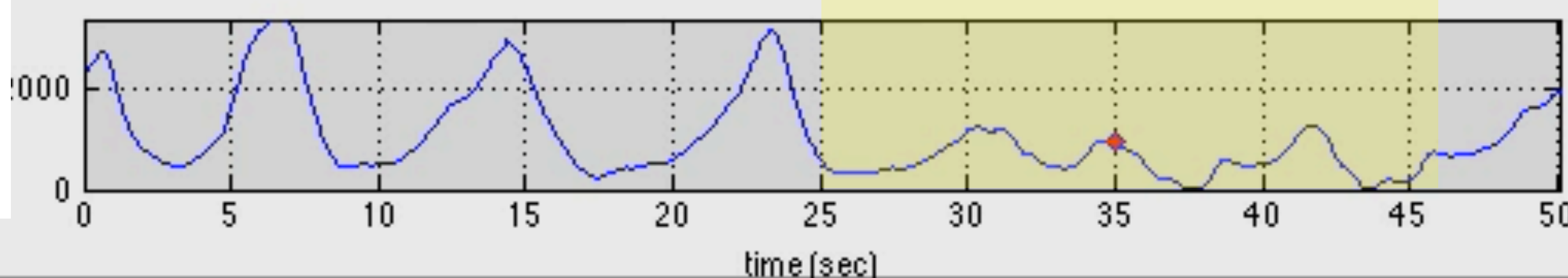
Mask  
Pressure



Airway  
Volume

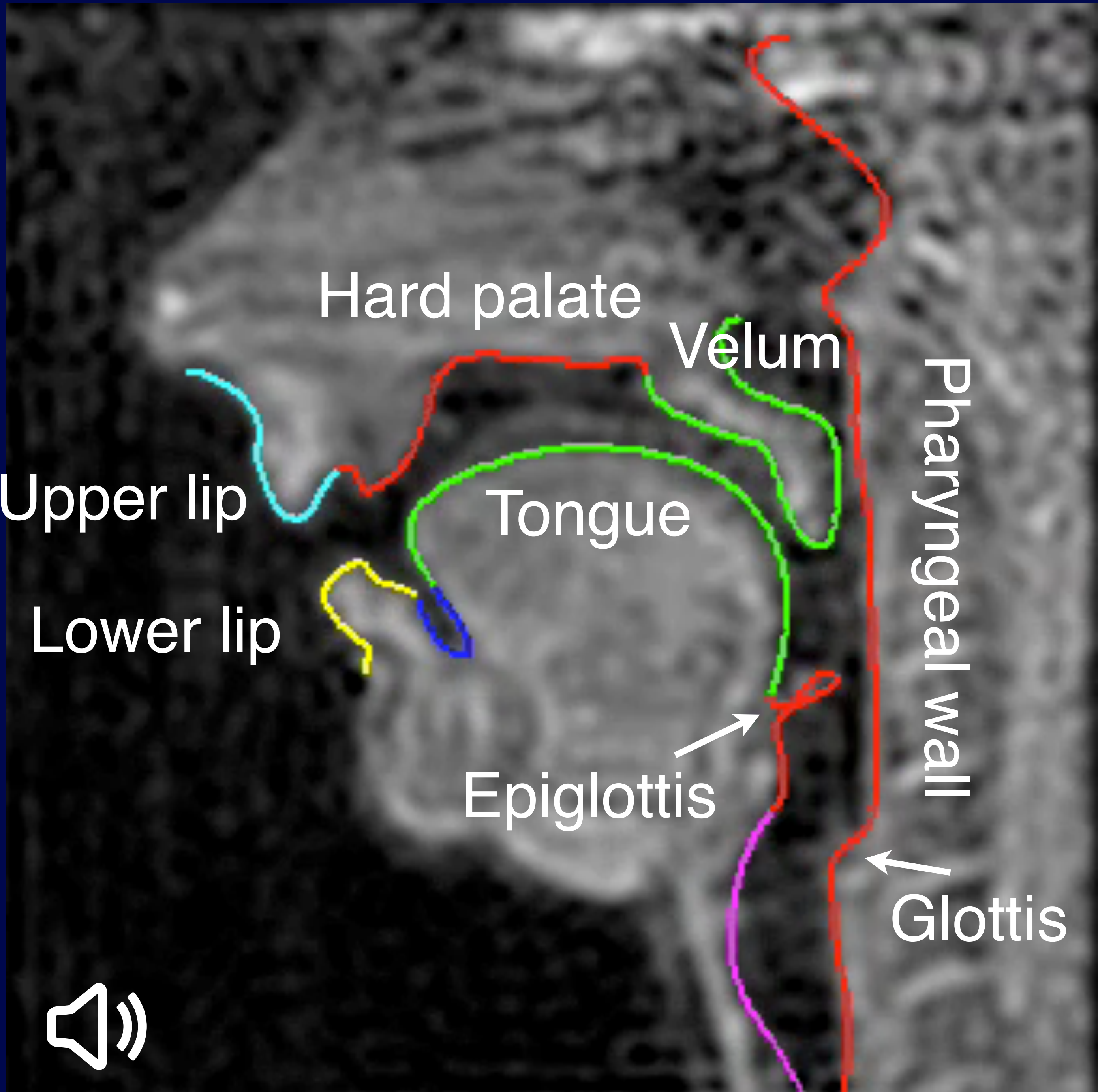


Respir.  
Effort



Balloon creates  
inspiratory load

Identify collapse  
pattern



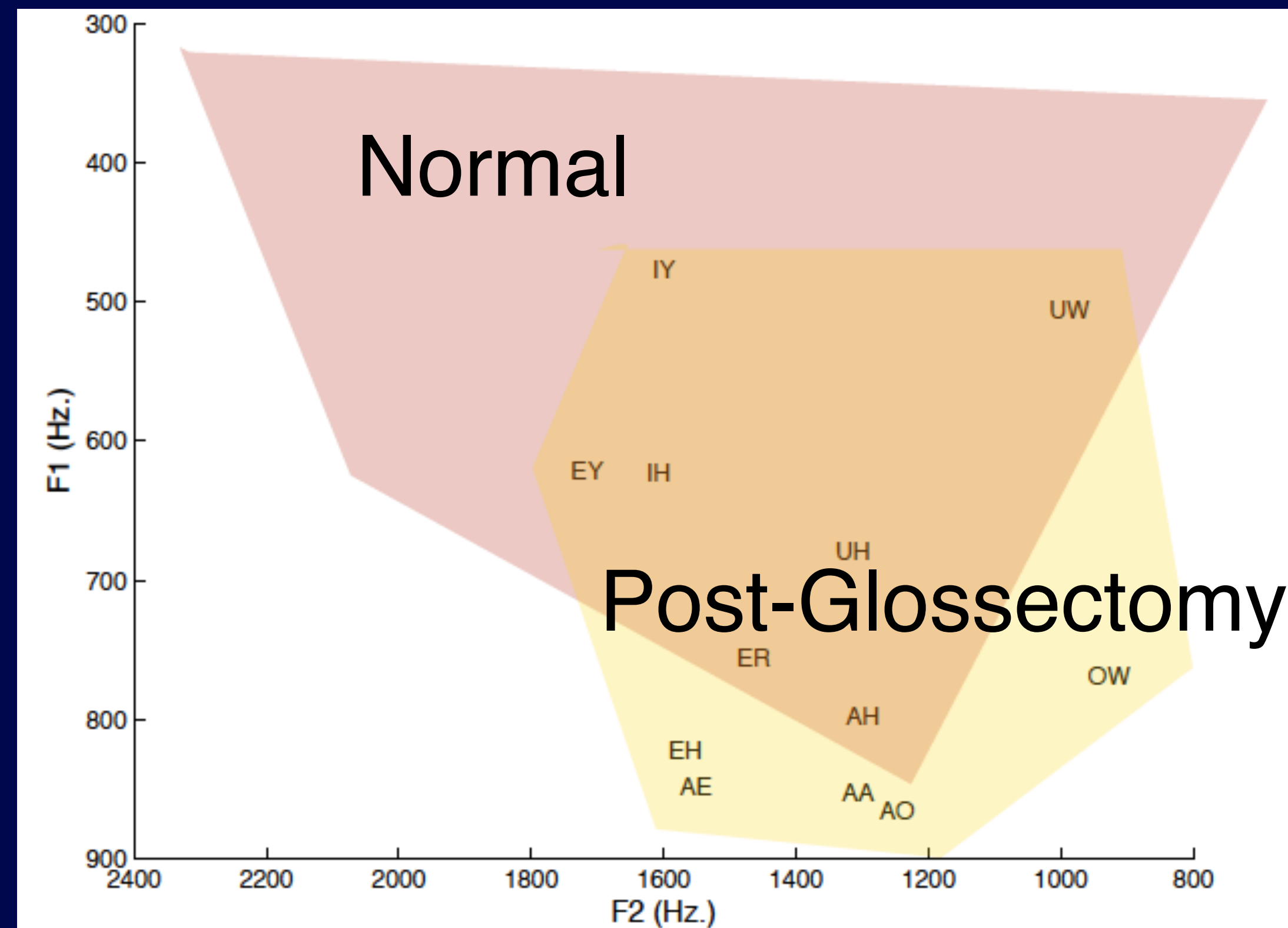




1.5T Spiral GRE + Constraint  
SG Lingala, et al. MRM 2017 77:112-125



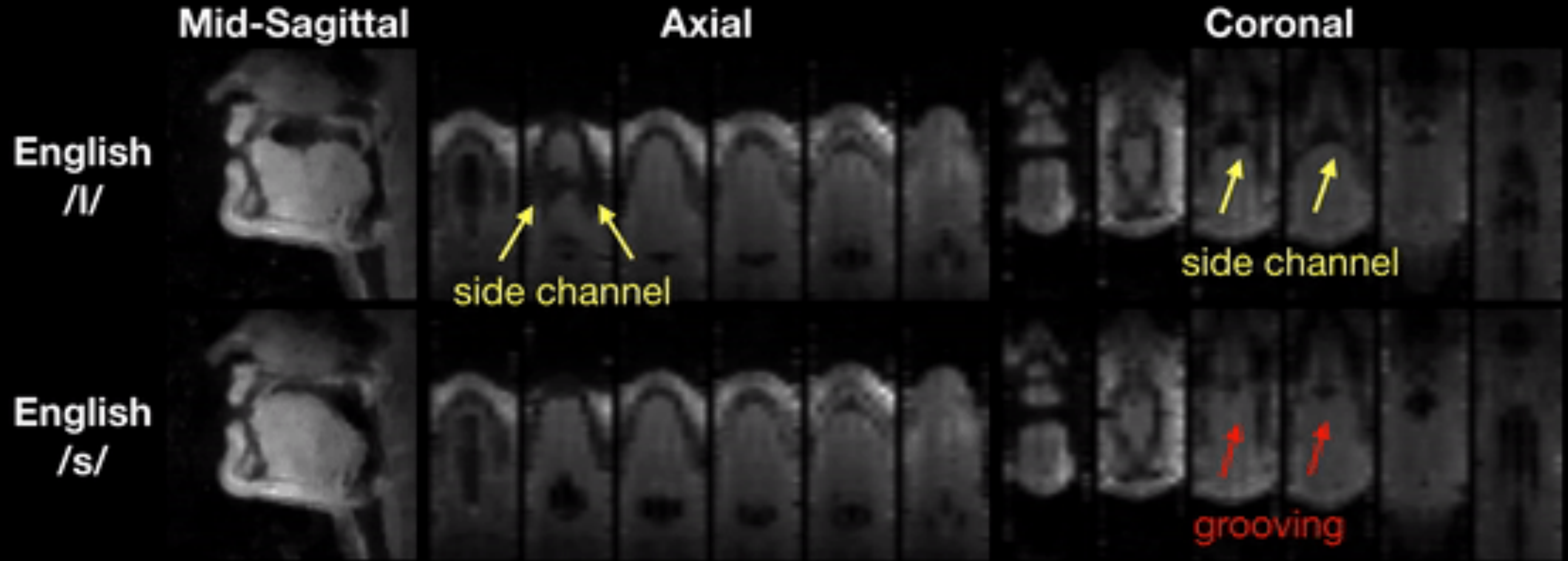
# Glossectomy



Y Zu et al., JAMA-Otolaryngology 139(12):1312-19  
C Hagedorn et al., JASA 2013 134:4205



# 3D Real-Time MRI



# Many Other Applications

## Diagnostic:

Musculoskeletal

Fetal

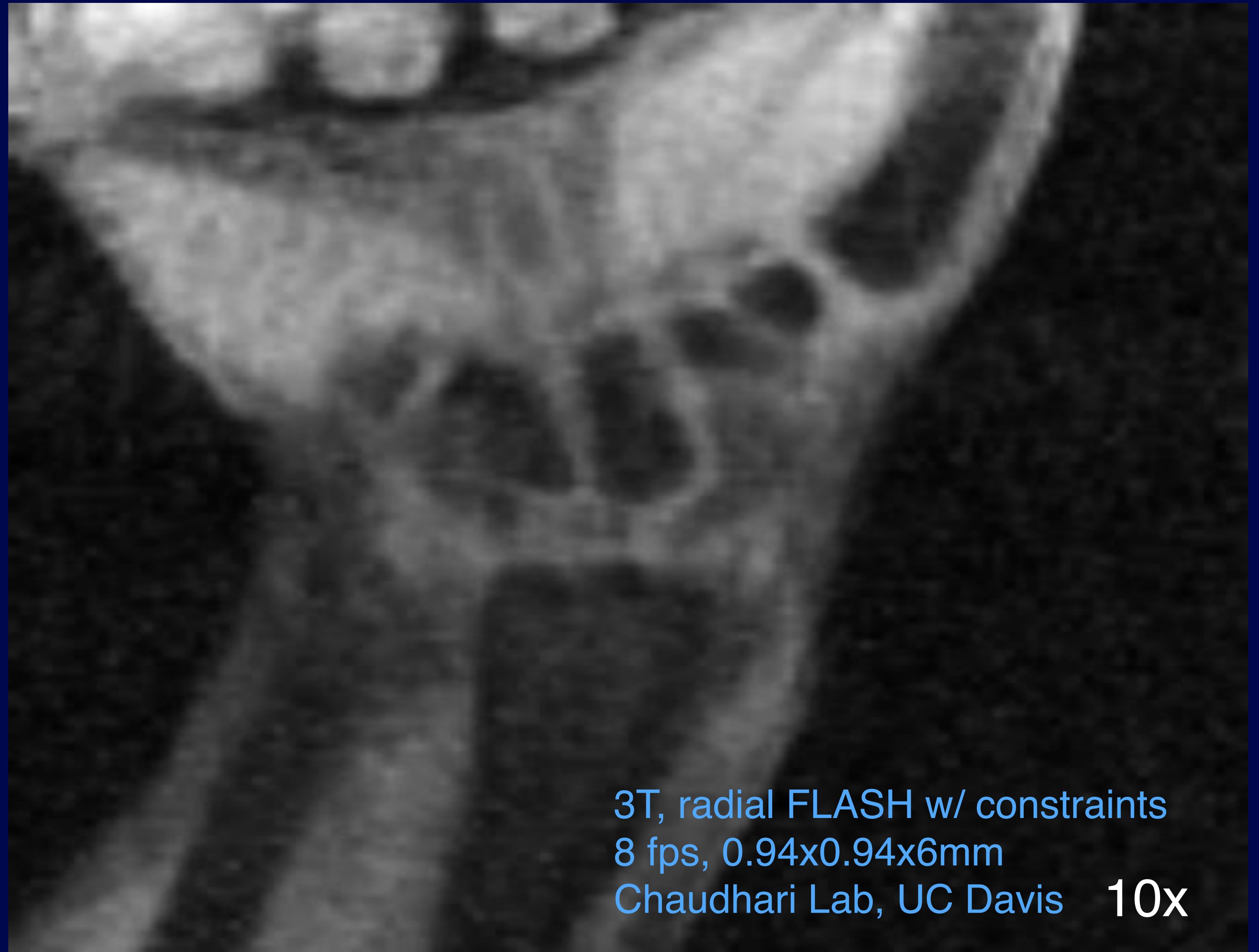
Gastrointestinal

Lung

## Supporting:

Localization

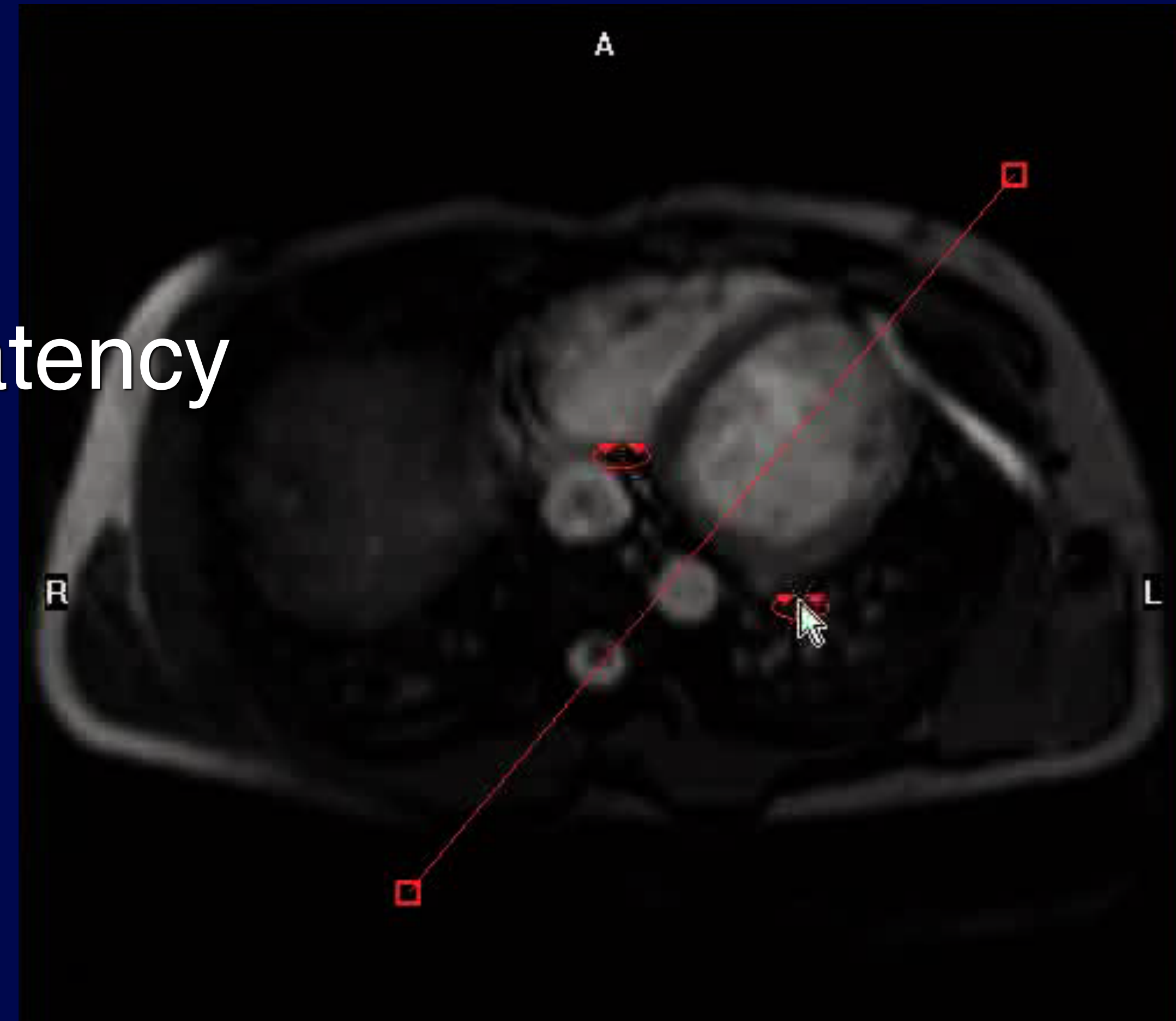
Navigators



3T, radial FLASH w/ constraints  
8 fps, 0.94x0.94x6mm  
Chaudhari Lab, UC Davis 10x

# Summary

- Real-Time Imaging has many driving applications, including Interventional CMR.
- Features:
  - speed, contrast, resolution, low latency
  - tool visualization
  - sequence switching
- You can do it!



# Acknowledgements

## Slide Content:

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