Houston Methodist Hospital
12th Annual Multimodality CV Imaging for the Clinician

Basic Concepts and New CMR Techniques

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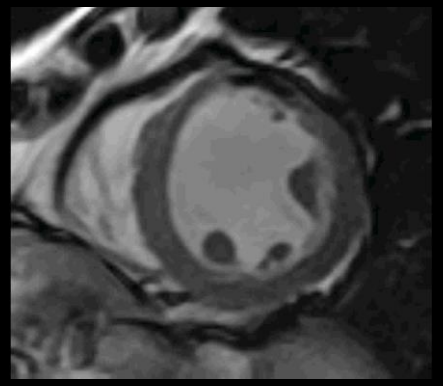
Presenter Disclosure Information

I have the following relevant financial relationships to disclose:

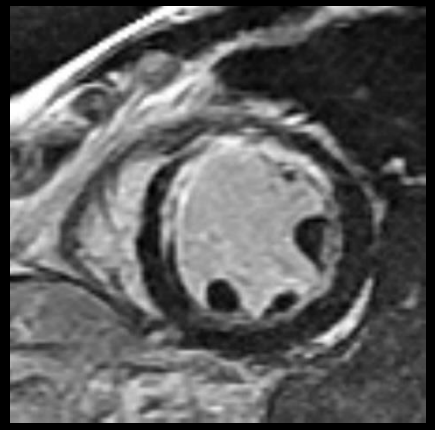
Employee of:	Brigham and Women's Hospital
Consultant for:	Bayer AG, Xylocor, Valo Health
Stockholder in:	None
Research support from:	NHLBI
	Bristol-Myers Squibb
	Alynlam Inc.
	Cytokinetics
Honoraria from:	None

Cardiac MRI for Assessing Heart Disease



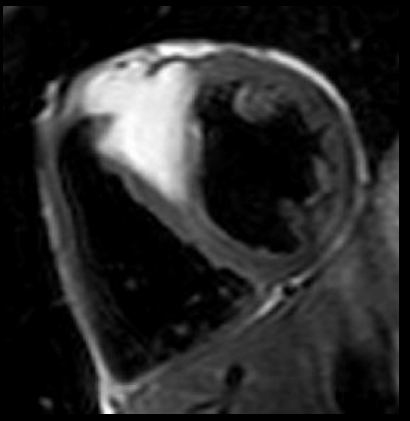
Function

Perfusion

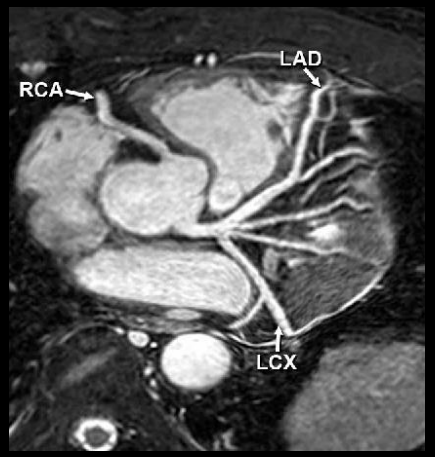


LGE (Scar)

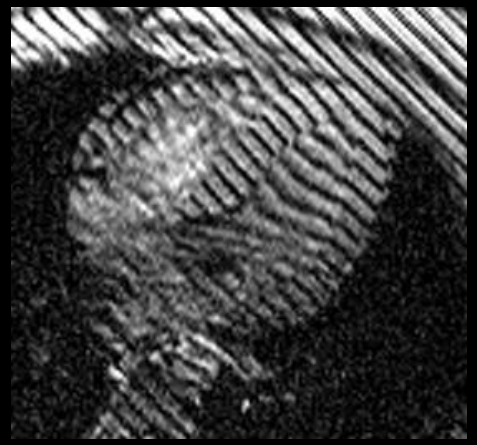
T2W = edema



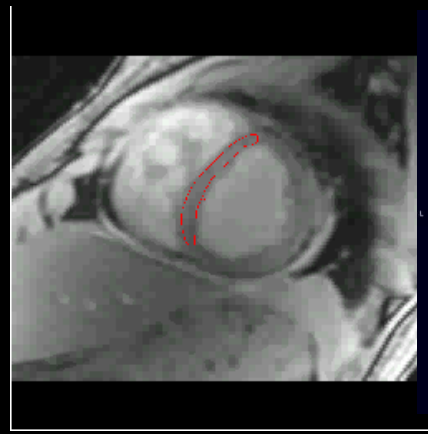
Fatty Infiltration



Coronary MRA

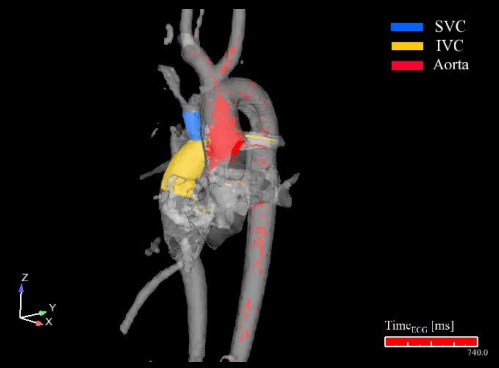


Myocardial Strain



T2* (iron)

Vasc Angio



Phase contrast (Vessel flow)

MRI is an image of ~~Water~~ H^+

Our Bodies are more than 80% water

Each tissue type has a unique frequency inside an MRI

The Larmor Equation

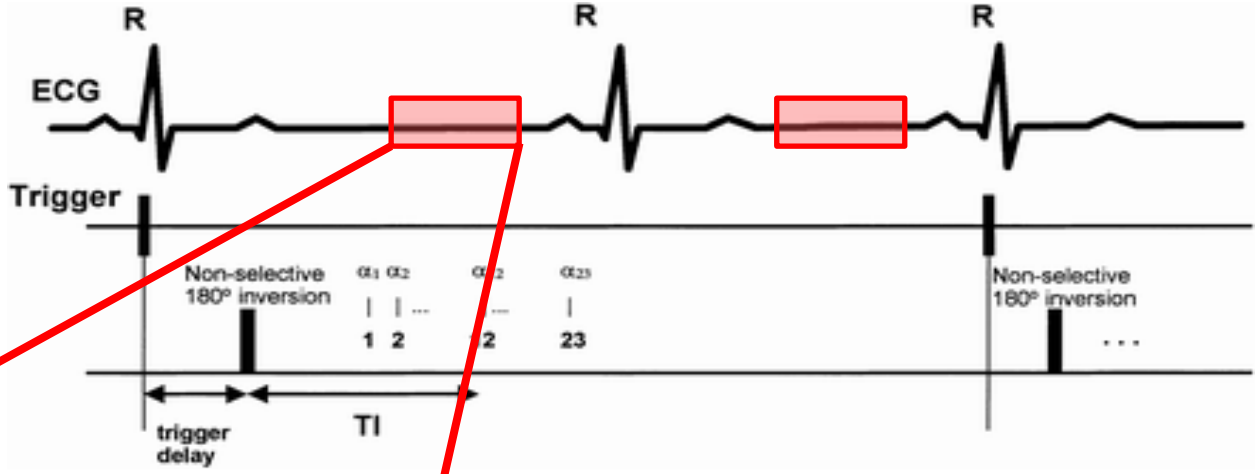
- **The larmor equation calculates the frequency of precession**
  - **Precessional frequency depends on**
    - **The type of nucleus**
    - **The strength of the external magnetic field**

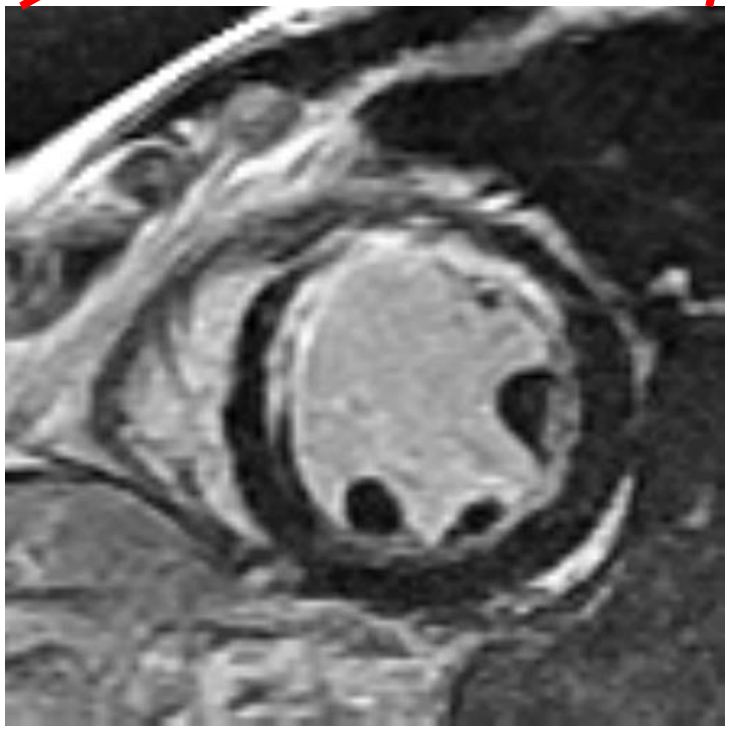
$$\omega = \gamma B_o$$

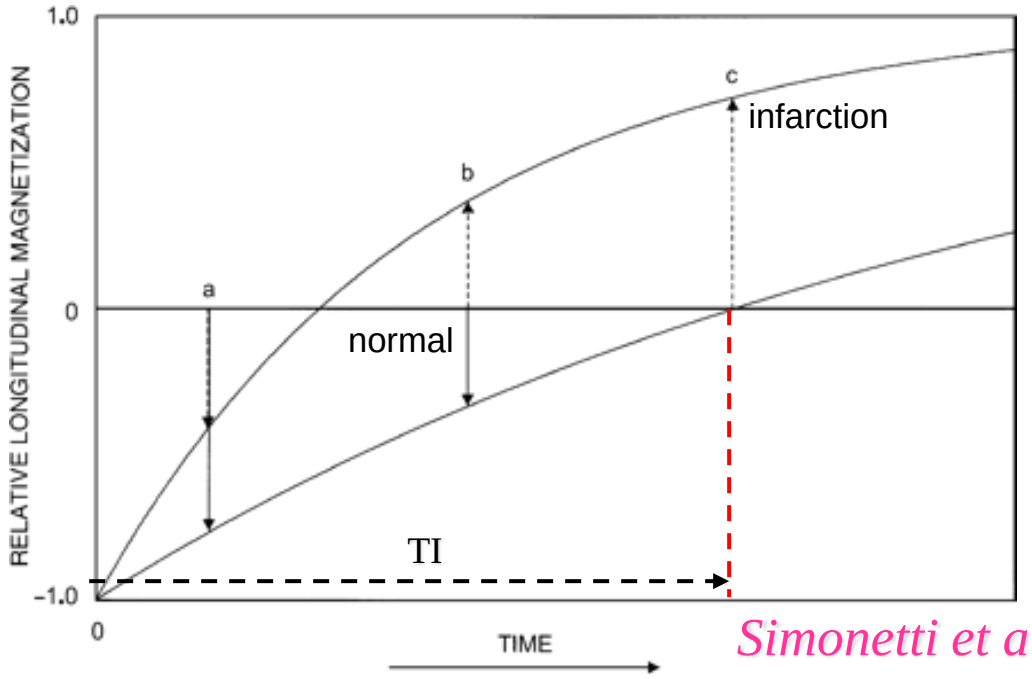
- ω: Omega or Precessional Frequency
- γ: Gamma or Gyromagnetic Ratio
- B_o: External Magnetic Field Strength

Manipulating this frequency (T1, T2, T2* etc) can extract different types of physiology of a given tissue type

Timing diagram: Late Gadolinium Enhancement (LGE)

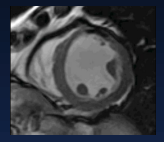




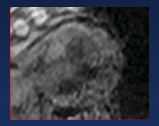


Simonetti et al.
Radiology 2001

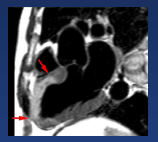
Components of a CMR



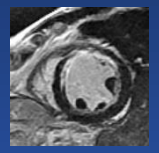
Cine: Cardiac Function



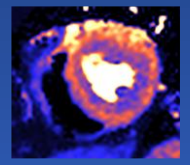
Myocardial perfusion: blood flow and flow reserve



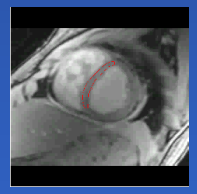
T2 Weighted: Myocardial edema



Late enhancement imaging: Scar/viability, infiltration



T1 and T2 mapping: inflammation/edema, infiltration



T2* mapping: myocardial iron content

Coronary and other MRA

Phase contrast: Blood Flow and velocity

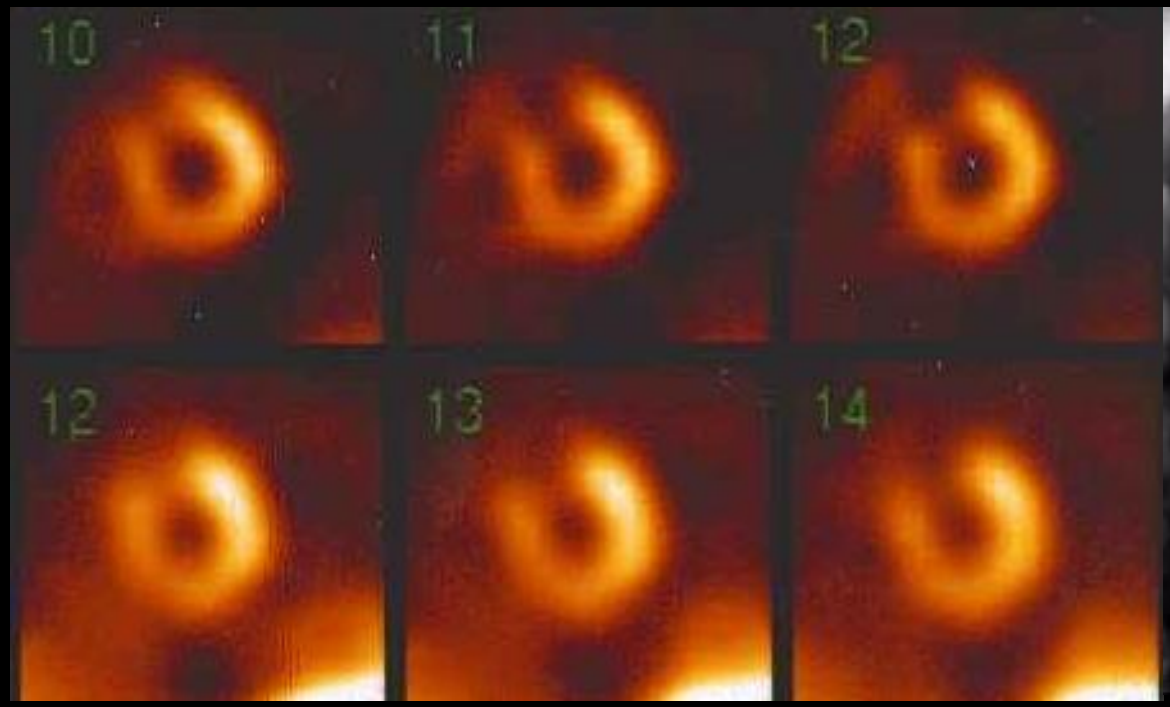
Why Cardiac MRI?

- Multiplanar arbitrary scan planes
- Highest tissue contrast compared to other modalities
- High spatial and temporal resolutions
- Advance by software (pulse sequence) improvement
- Multi-component imaging for cardiac structure and physiology
- Noninvasiveness, lack of ionizing radiation

New Techniques

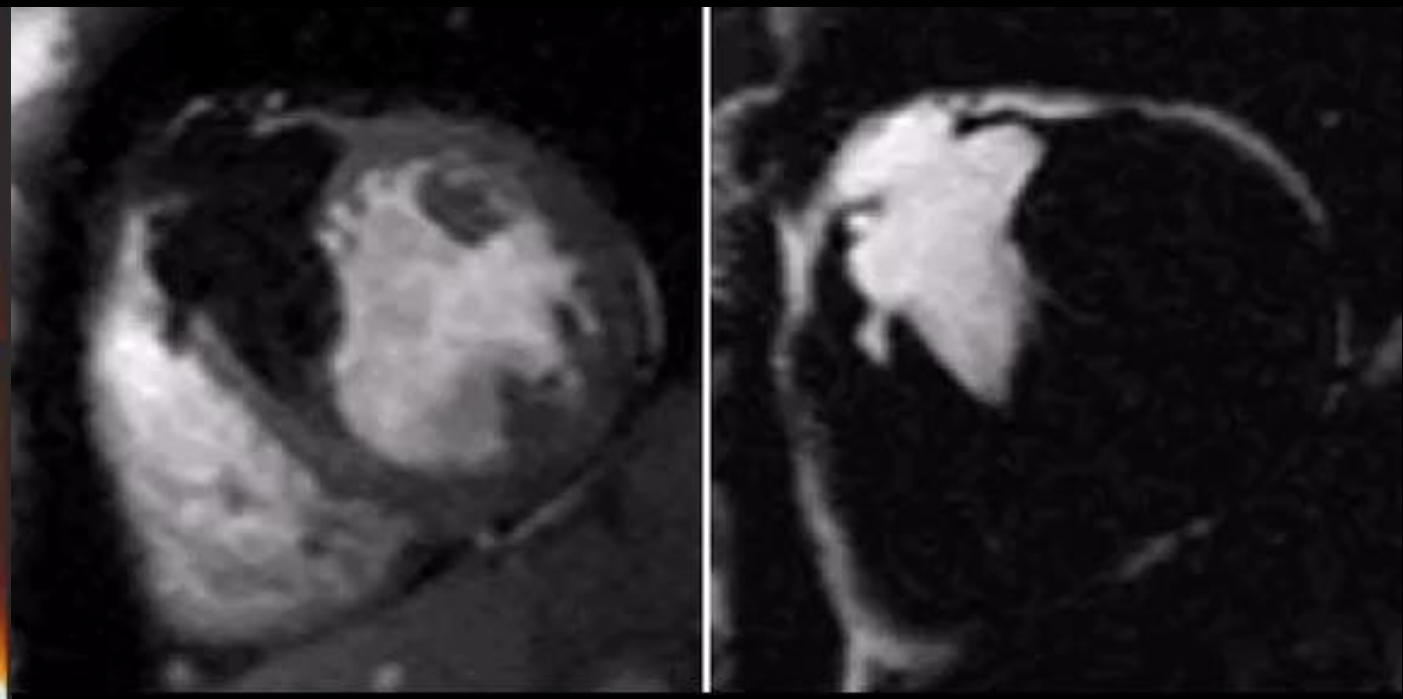
A 48-year-old female underwent preoperative stress nuclear imaging

a fixed anteroseptal defect was revealed which was reported as consistent with myocardial infarction



Water

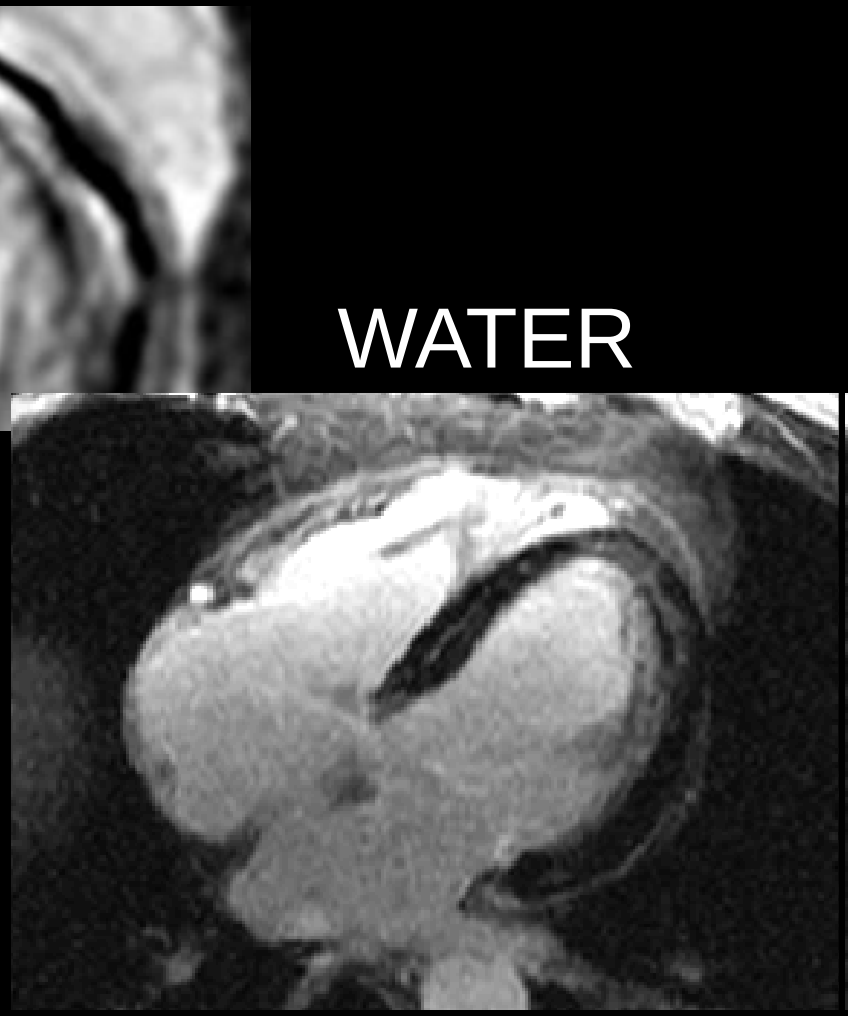
Fat

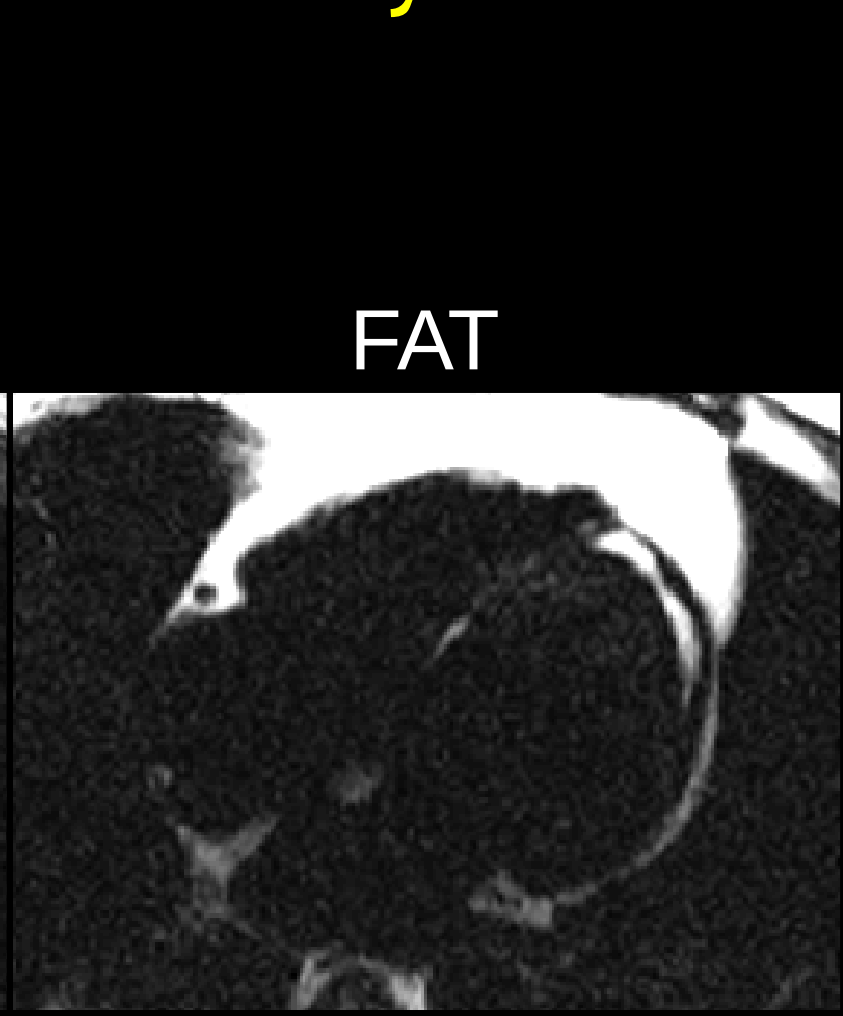


Courtesy of Peter Kellman PhD, NHLBI

50 yo with VT and wall motion abnormality

conventional PSIR
late enhancement





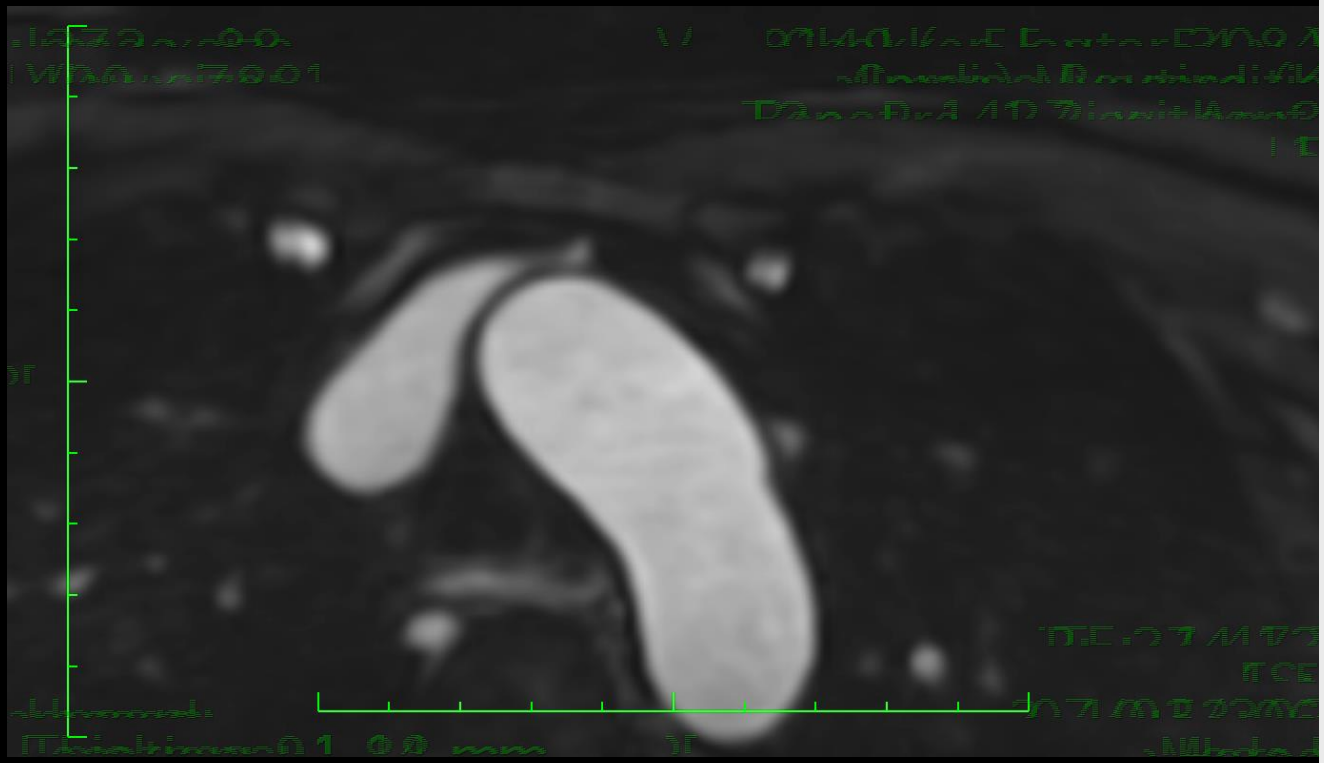
multi-echo PSIR
fat/water separated
late enhancement

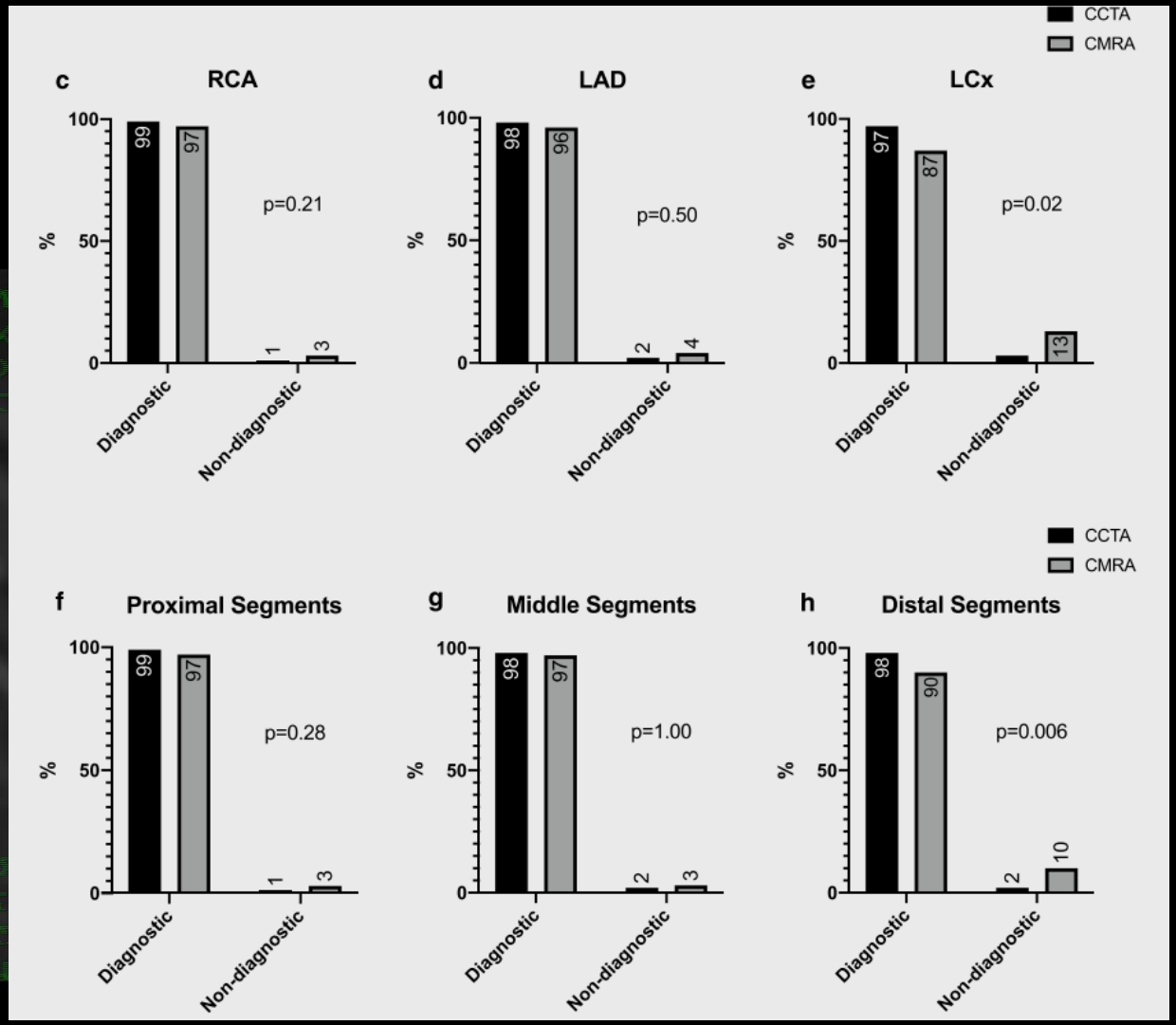
Courtesy of Peter Kellman PhD, NHLBI

Non-contrast Coronary MRA

- Self-navigated, collects data in all respiratory cycles
- No need for any contrast agents
- Cardiac motion corrected
- 0.9 mm isotropic resolution
- 3D Plug and play (no vessel planning steps)

Courtesy of R. Botnar et al
JCMR 2021

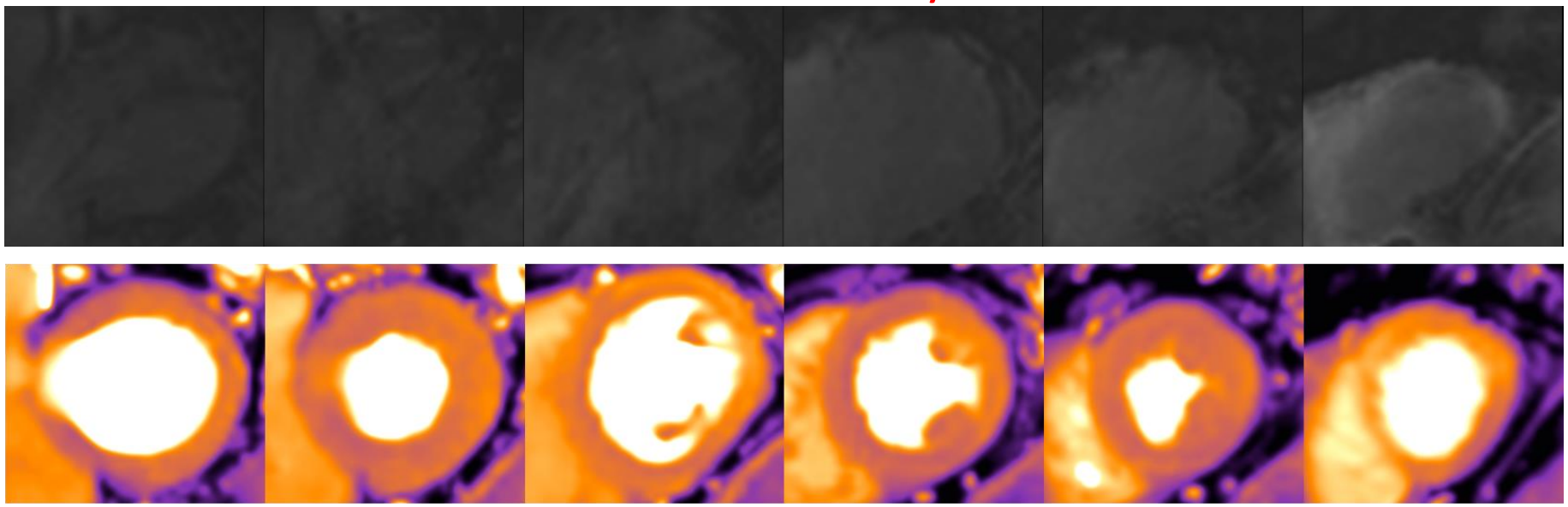




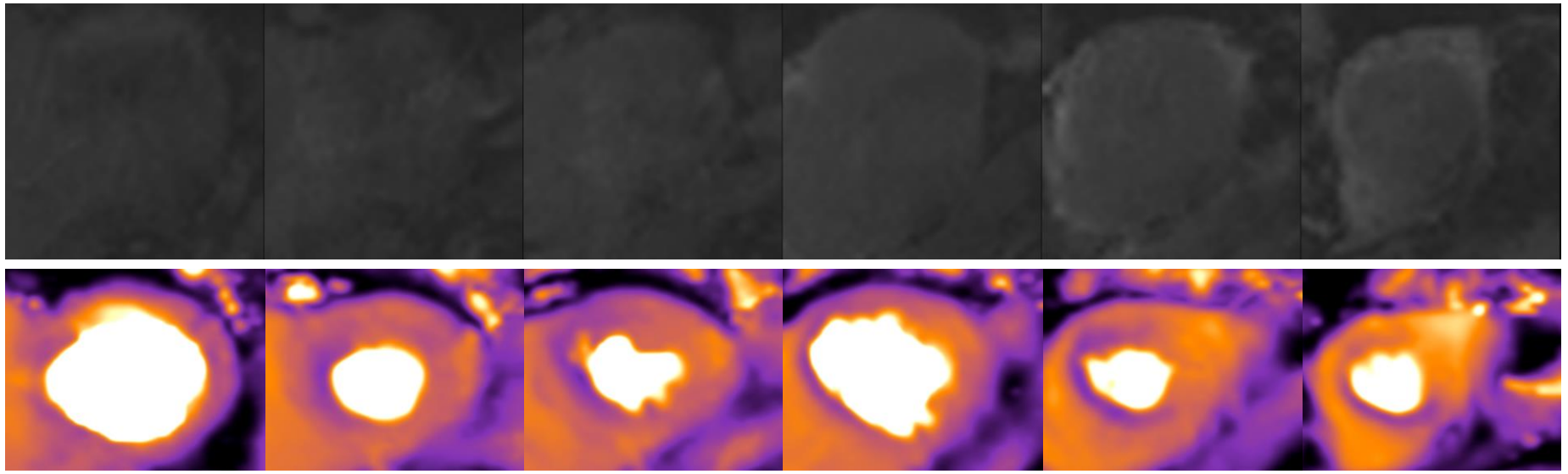
KING'S College LONDON

KING'S HEALTH PARTNERS

Unobstructed coronary arteries



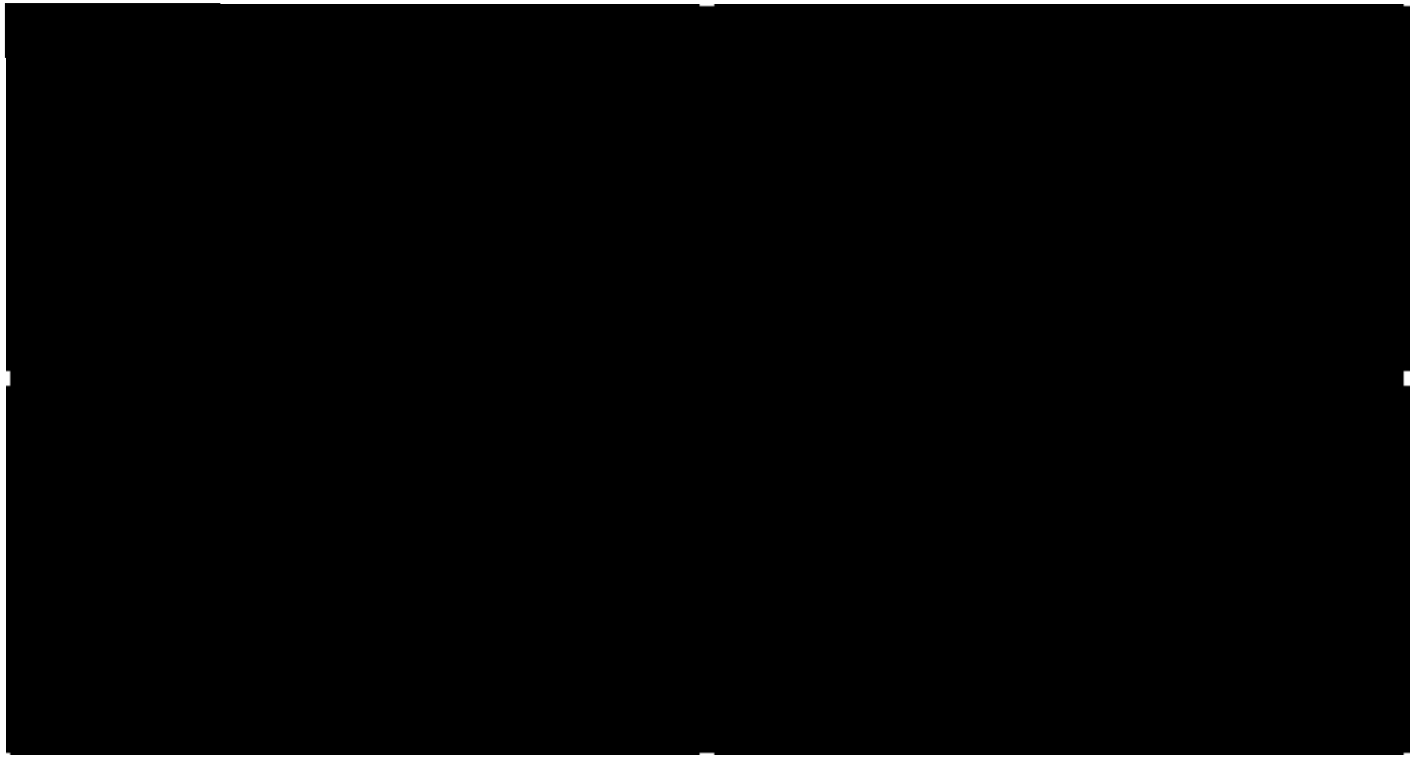
Proximal LAD Stenosis



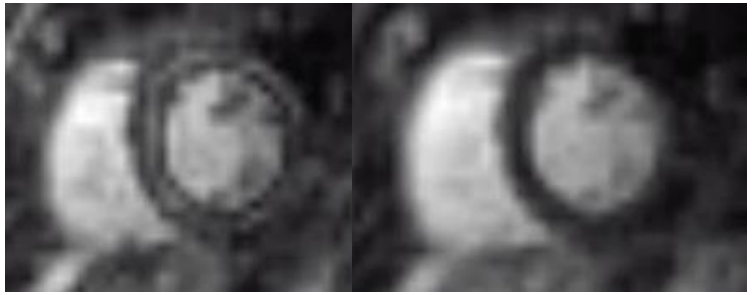
Courtesy: Sohaib Nazir, Amedeo Chiribiri, King's College London

AI-assist CMR Scanning

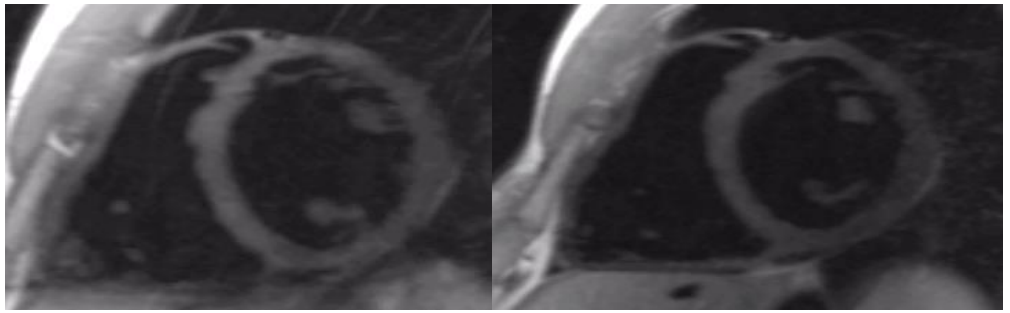
1) Planning



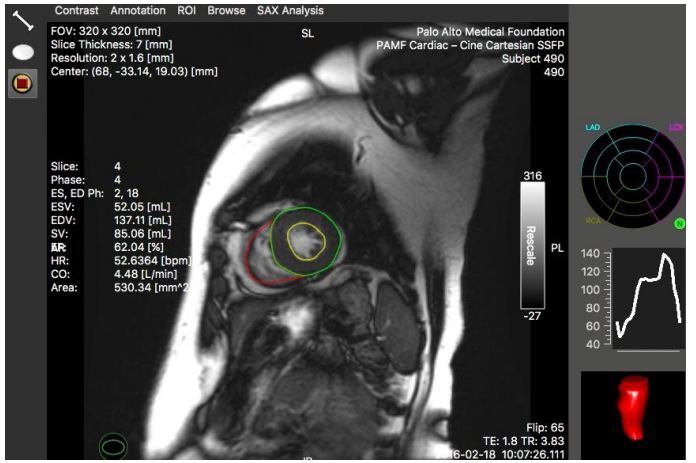
2) Tuning



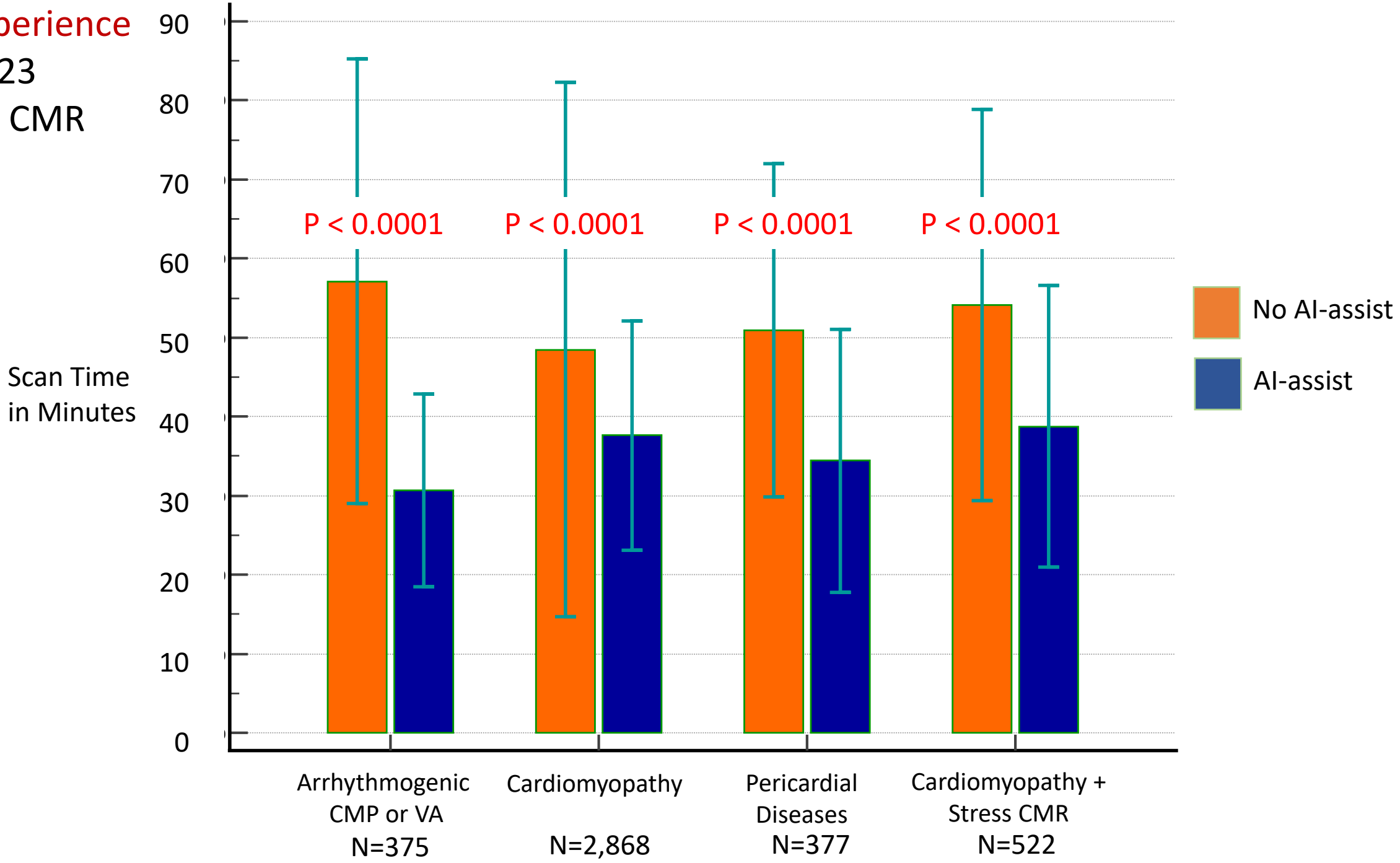
3) Monitoring

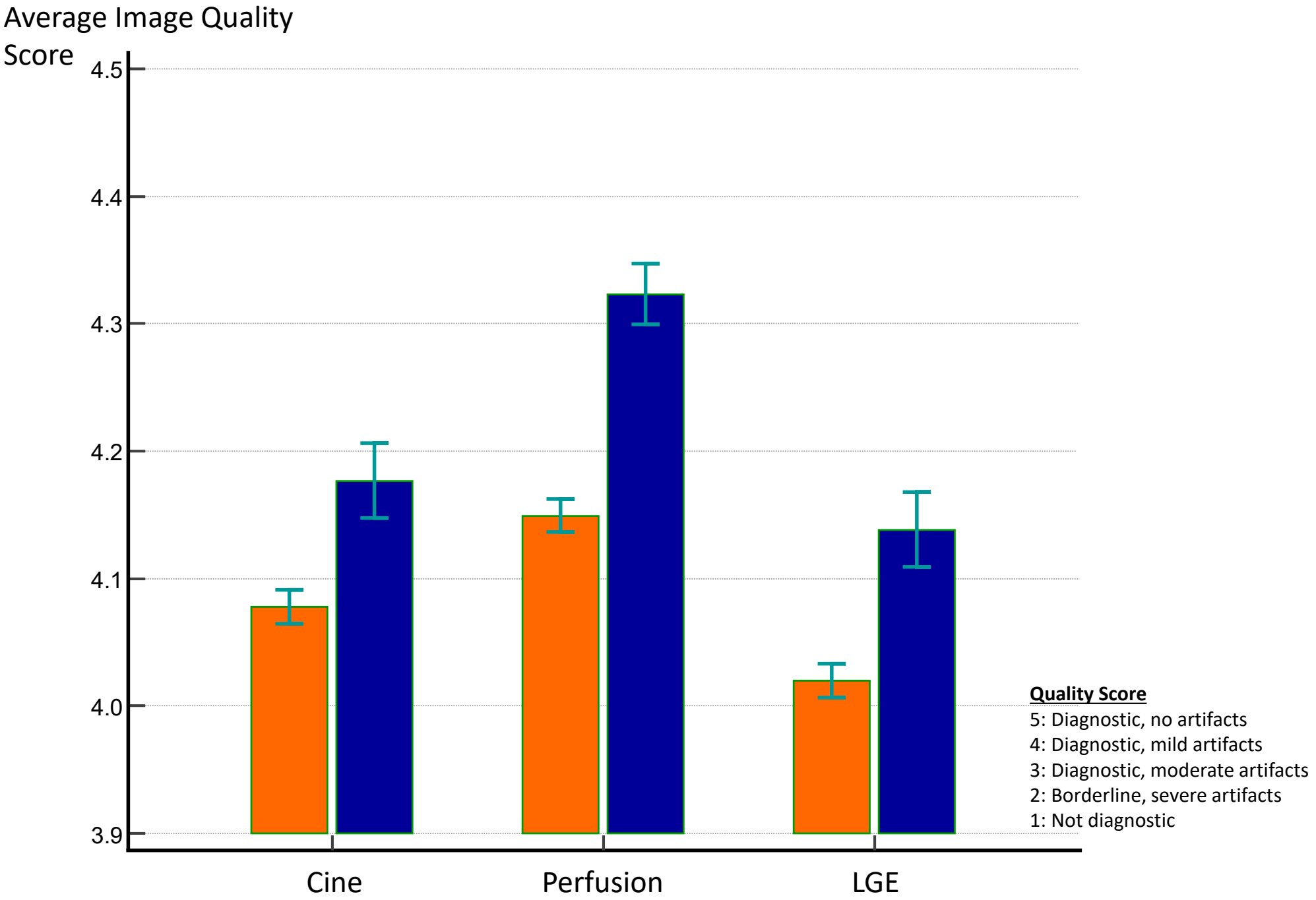


4) Analyzing



BWH experience
2021-2023
N=4,142 CMR Studies




Average Image Quality Score
4.5
4.4
4.3
4.2
4.1
4.0
3.9
Cine
Perfusion
LGE
Quality Score
5: Diagnostic, no artifacts
4: Diagnostic, mild artifacts
3: Diagnostic, moderate artifacts
2: Borderline, severe artifacts
1: Not diagnostic

Thank you

Monthly Proportion of Diagnostic CMR Studies that Failed or Succeeded to Complete in <= 45 minutes, Before and After Adopting AI-Assist