CMR Postprocessing - clinical practice and unmet needs

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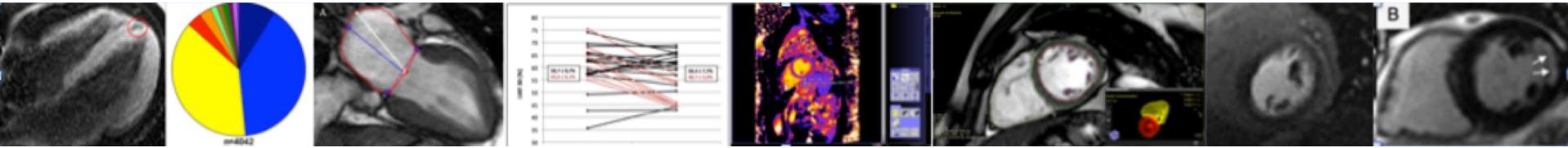

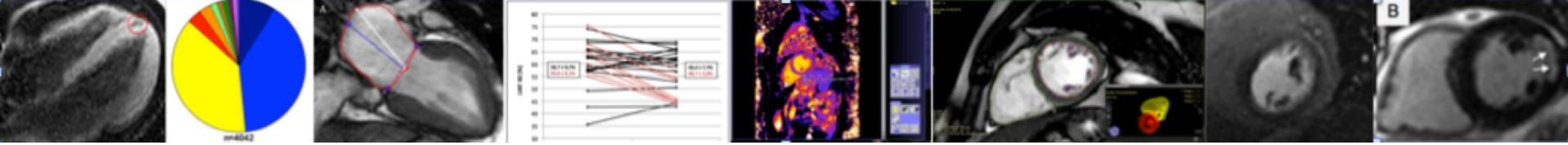

Disclosure

- **Institutional Research Collaboration/Grants:**
  BMBF; Deutsche Herzstiftung, Charité, DFG, DZHK, HELIOS-Research Center; NIH
  circle international, medis, Siemens Healthineers

- **Scientific Advisory Board:**
  Bayer AG , Circle cvi, Siemens healthineers

- **Speakers honorary:**
  circle-institute


ESC
European Society of Cardiology
European Heart Journal (2021) 42, 3599–3726
doi:10.1093/eurheartj/ehab368
2021 ESC Guidelines for the diagnosis and
treatment of acute and chronic heart failu
Authors/Task Force Members: Theresa A. McDonagh* (Chairperson) (U
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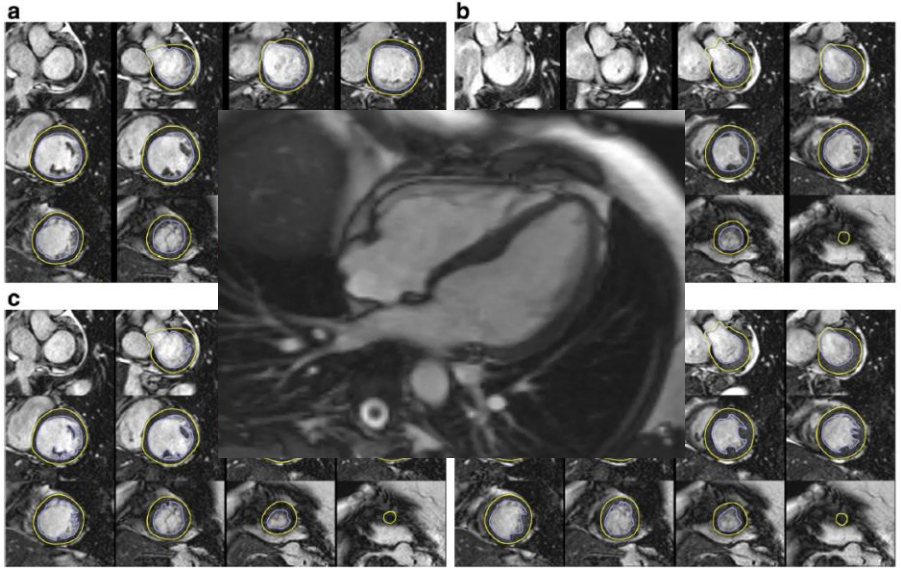
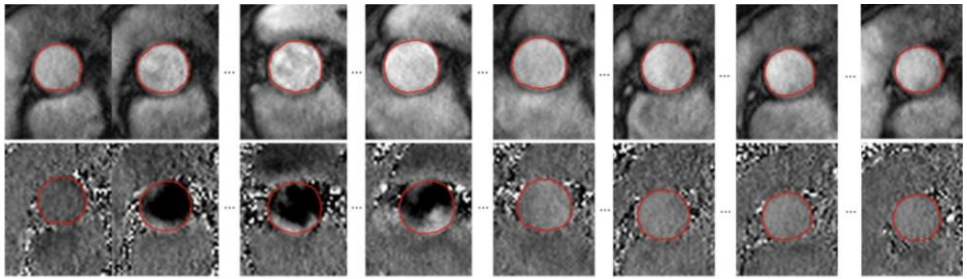
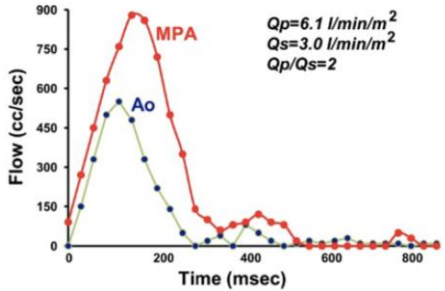
Andrew J.S. Coats (United Kingdom), Maria G. Crespo-Leiro (Spain),
Dimitrios Farmakis (Greece), Martine Gilard (France), Stephane Heyma
CMR more and more included at a high level of evidence

CMR - Decision-making based on Quantification

precision needed

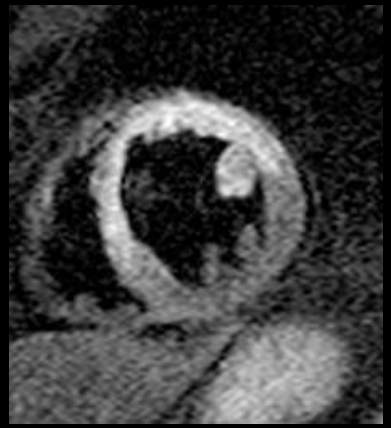


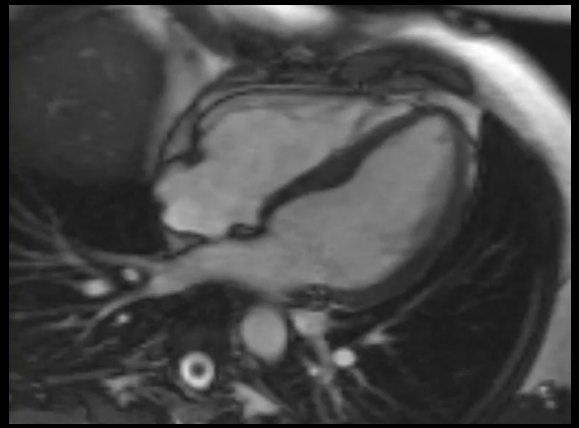


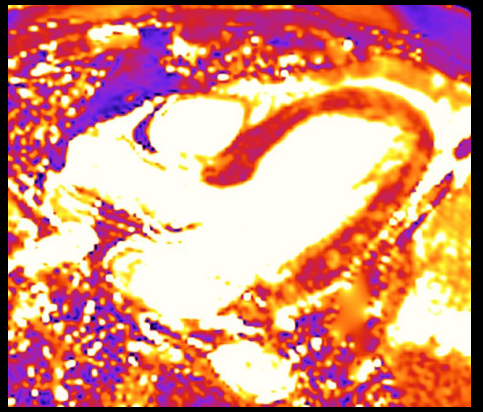


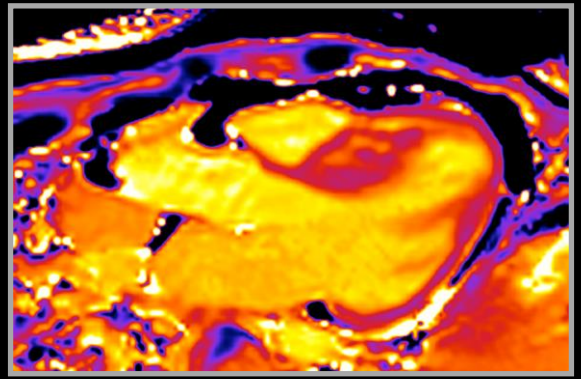
Schulz-Menger et al JCMR 2020 (SCMR Update Post-Processing in CMR)

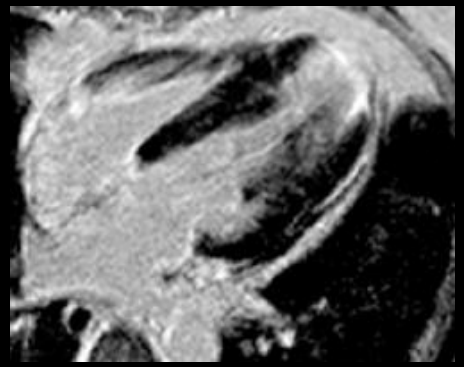
Unique Capability of CMR - Myocardial Tissue Differentiation





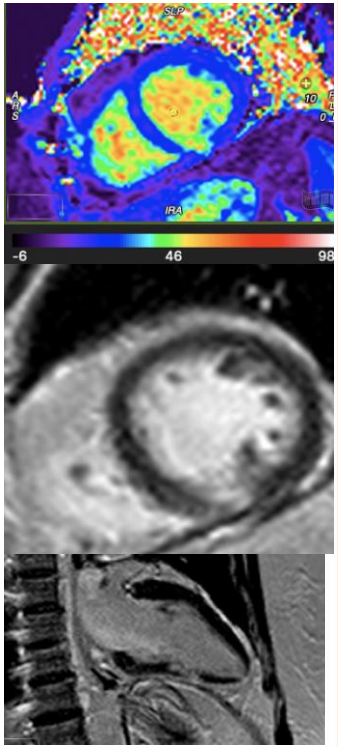


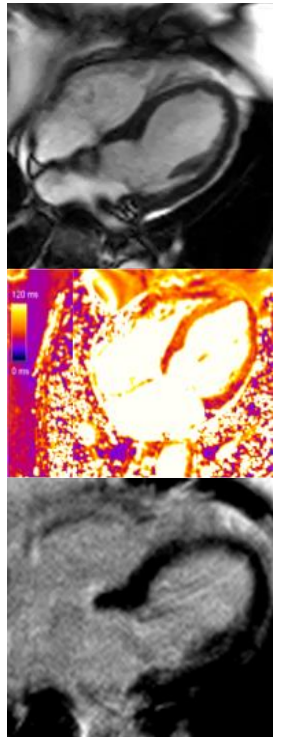




ESC Guidelines 2020

Acute Coronary Syndrome without ST-Elevation (NSTEMI)





Clinical Presentation

Rise and/or fall of cardiac troponin with one value >99th percentile ULN
+
Ischaemic signs/symptoms
+
Non-obstructive CAD (<50% lesion)

Working Diagnoses

Exclude:
- Missed obstruction (ischaemic reasons)
- Myocardial injury (non-ischaemic reasons)

MINOCA
(Ischaemic reasons)

Diagnostic Work-Up

LV Functional Assessment (LV Angiogram, Echo)

Consider clinical context (clinical alternative overt diagnoses)

Review angiography findings (clinically overlooked diagnoses)

CMR Imaging

Non ischaemic pattern

ischaemic pattern

Intravascular Imaging (IVUS or OCT)

Intracoronary functional testing (Acetylcholine/Ergonovine)

Diagnosis

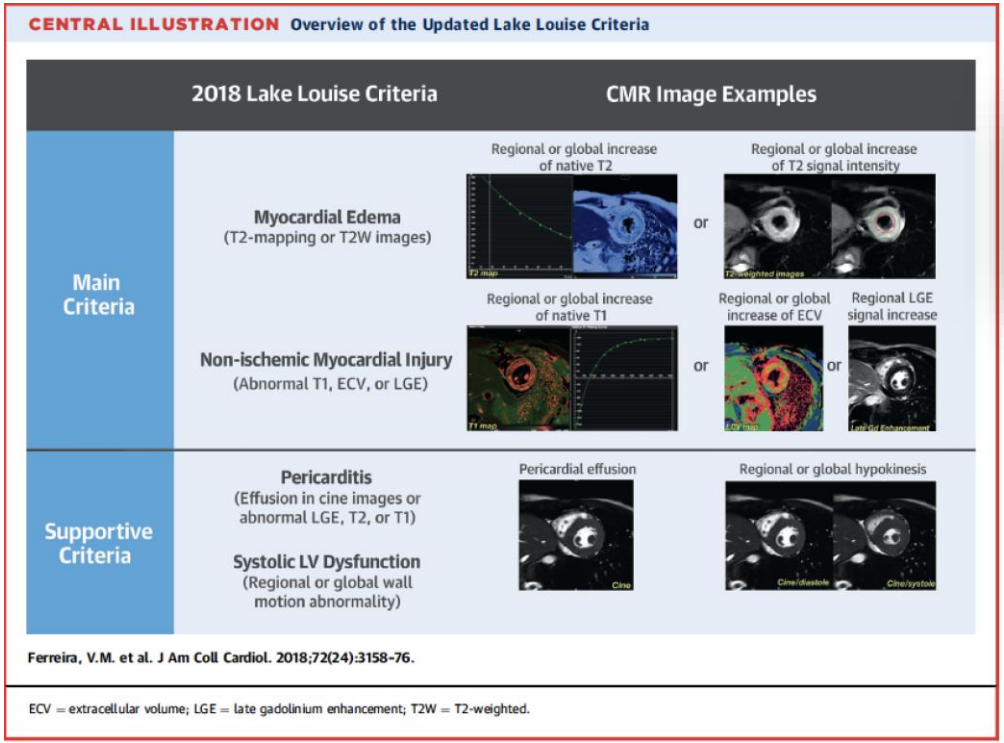
Alternative Diagnoses
- Sepsis
- Pulmonary embolism
- Cardiac contusion
- Aortic dissection
- Other non-cardiac troponin rise

True MI
- Obstructive CAD
- SCAD

Specific Non-MINOCA
- Takotsubo syndrome
- Other cardio-myopathies
- Myocarditis

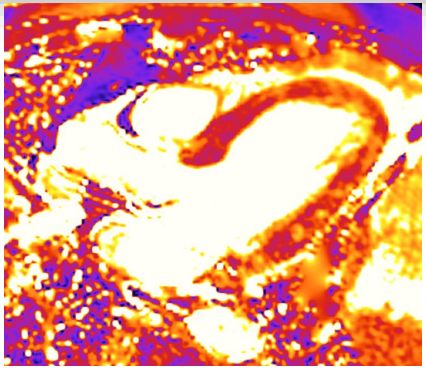
Specific Ischaemic Diagnoses
- Unclassified MINOCA
- Plaque rupture
- Plaque erosion
- Coronary emboli/ thrombus
- SCAD
- Coronary artery spasm
- Micro-vascular disease

Inflammation



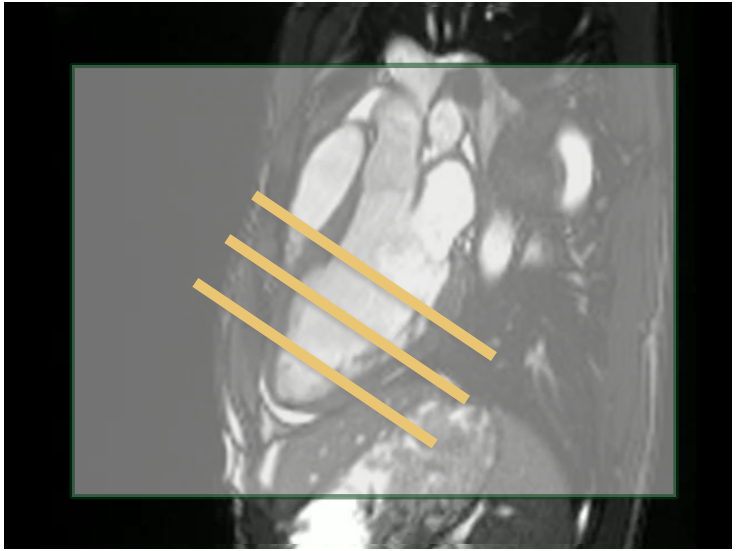
CMR **mandatory** test

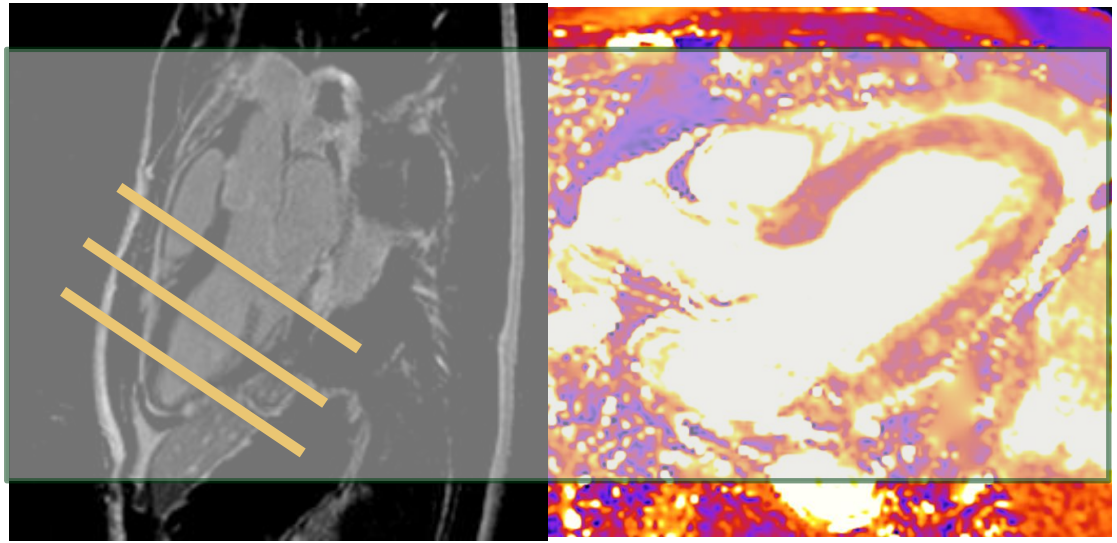
(ESC Guidelines Heart Failure 2021)



Ferreira et a JACC 2029

Inflammation - impact of scan protocol





full coverage versus
1. patient status
2. scan time

often small focal findings

Messroghli et al. Journal of Cardiovascular Magnetic Resonance (2017) 19:75
DOI 10.1186/s12968-017-0389-8

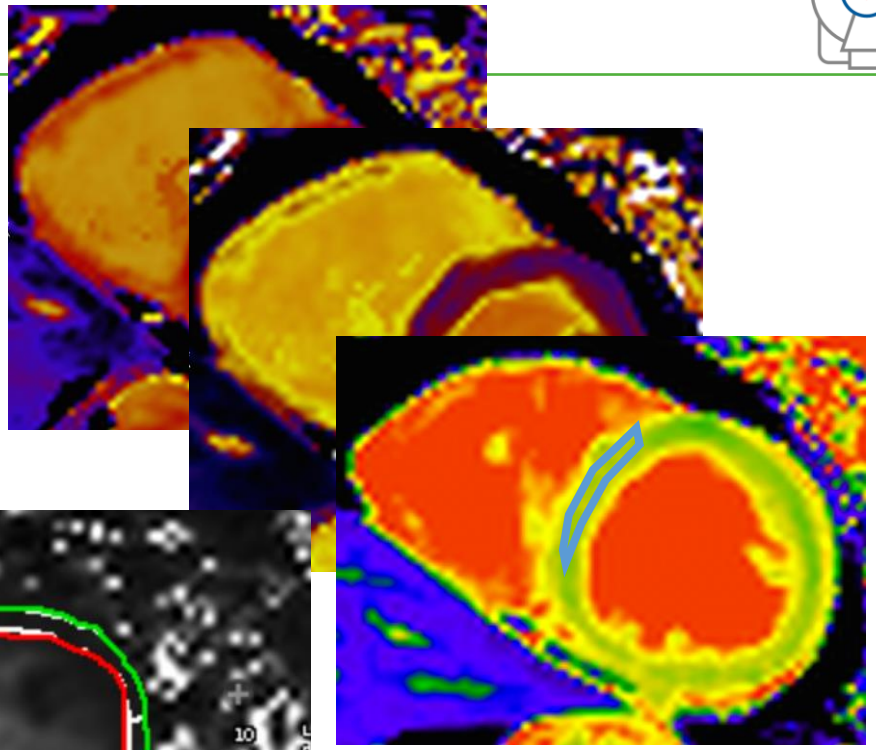
Journal of Cardiovascular Magnetic Resonance

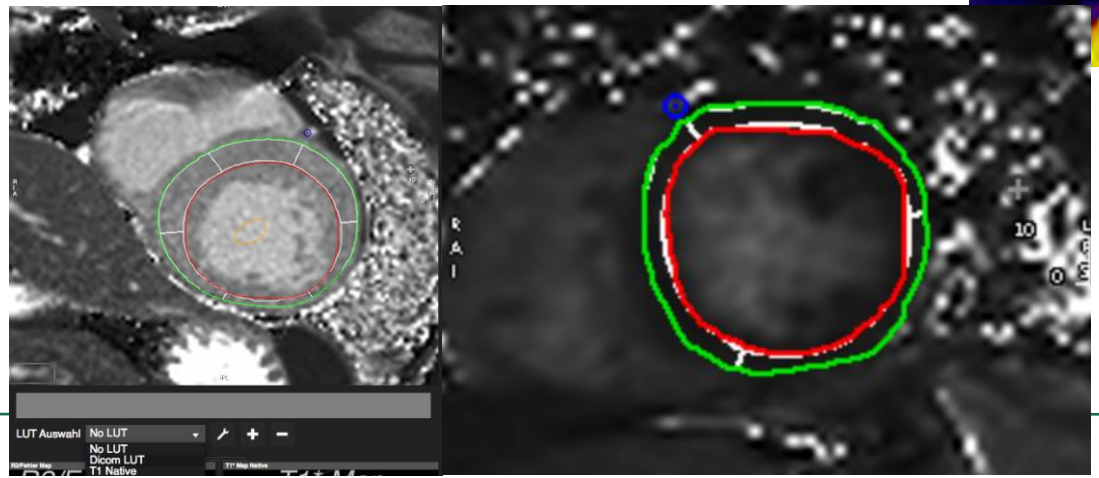
working group for CMR Charité / ECRC Helios

REVIEW Open Access

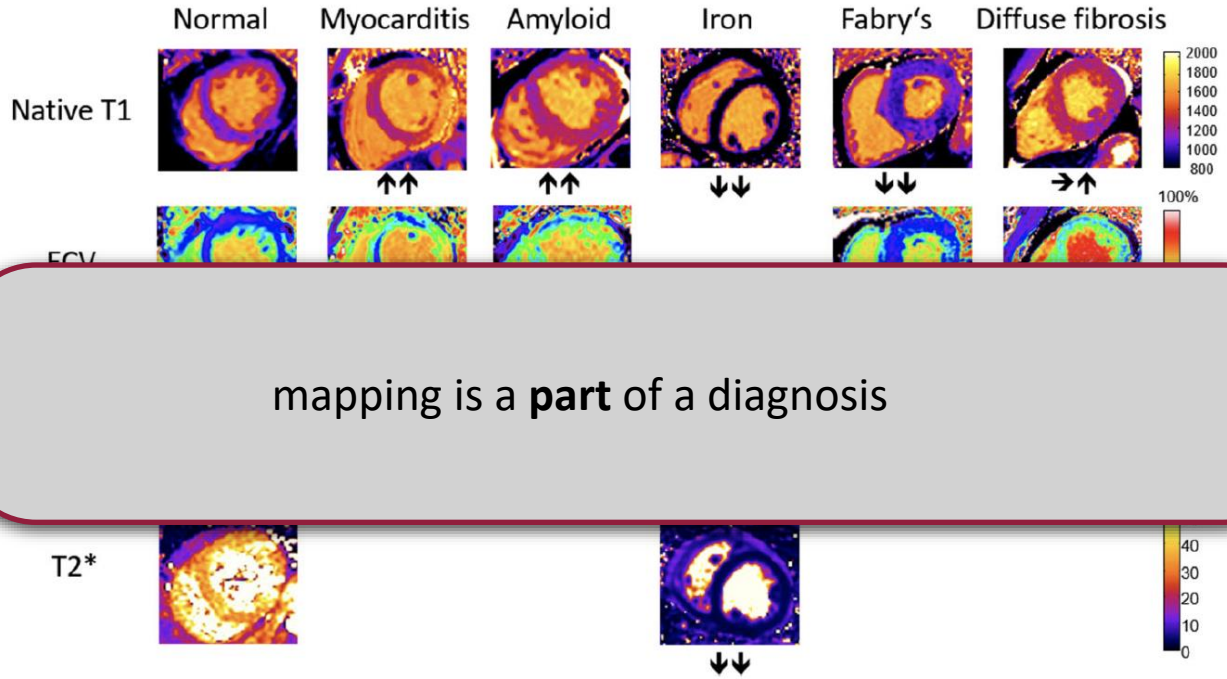
Clinical recommendations for cardiovascular magnetic resonance mapping of T1, T2, T2* and extracellular volume: A consensus statement by the Society for Cardiovascular Magnetic Resonance (SCMR) endorsed by the European Association for Cardiovascular Imaging (EACVI)

Daniel R. Messroghli[1,23*], James C. Moon[4], Vanessa M. Ferreira[5], Lars Grosse-Wortmann[6], Taigang He[7], Peter Kellman[8], Julia Mascherbauer[9], Reza Nezafat[10], Michael Salerno[11], Erik B. Schelbert[12,13,14], Andrew J. Taylor[15], Richard Thompson[16], Martin Ugander[17], Ruud B. van Heeswijk[18] and Matthias G. Friedrich[19,20,21,22]





Diagnosis

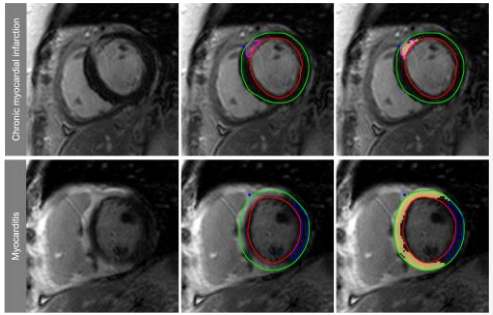


mapping is a **part** of a diagnosis

Fig. 1 Typical appearance of T1, T2, T2*, and ECV maps in healthy subjects and in patients with myocardial disease. Arrows denote relative change in respective parametric maps. Courtesy of P.K

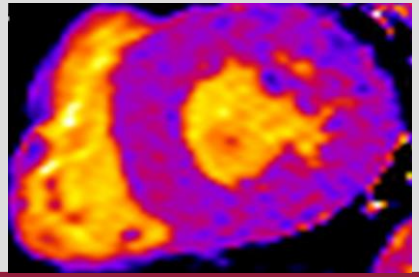
Messroghli et al JCMR 2017

Increase of Quantification - Chance and Challenge



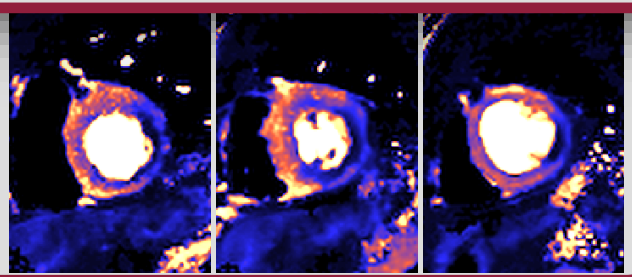
LGE

- is there a need?
- added value - routine, near future, far away ?



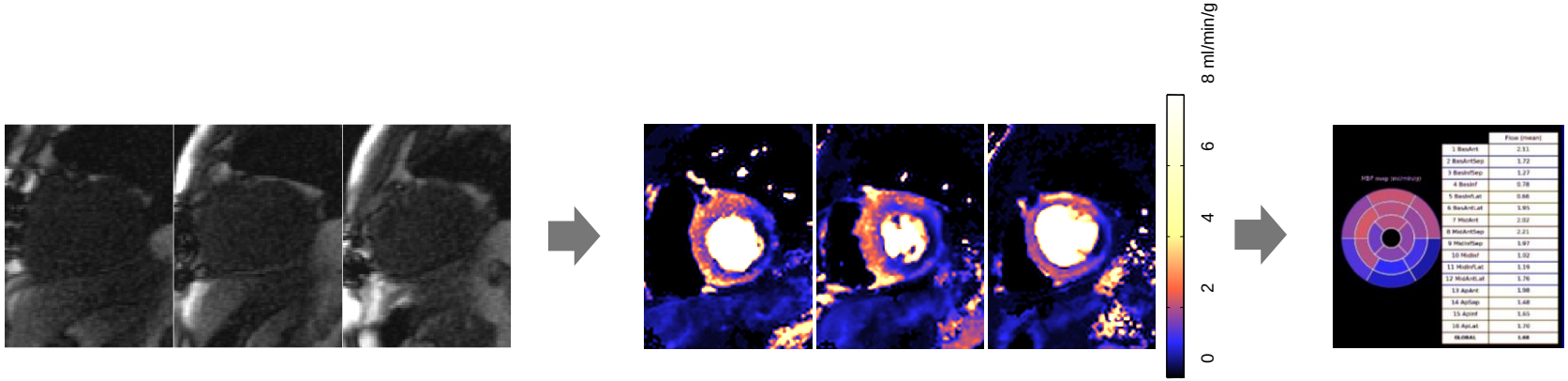
mapping

inline application



quantitative perfusion (thx to Peter Kellmann)

Inline Quantitative Myocardial Perfusion Flow Mapping

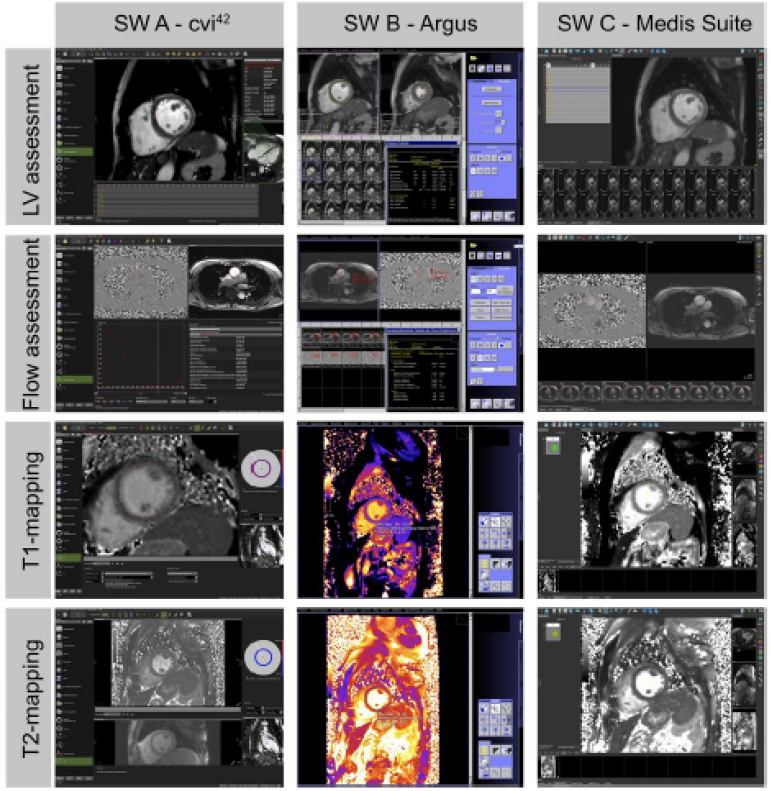


- Objective assessment
- Speeds analysis
- In-line quality assessment

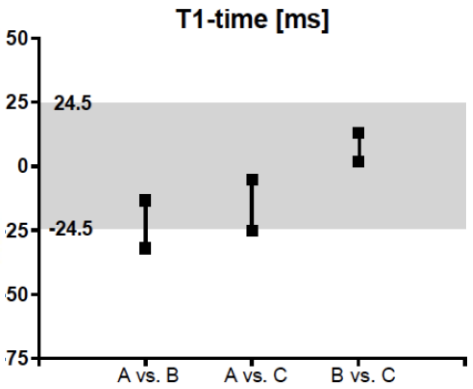
(thx to Peter Kellmann)

Quantification - Quality Assurance Needed

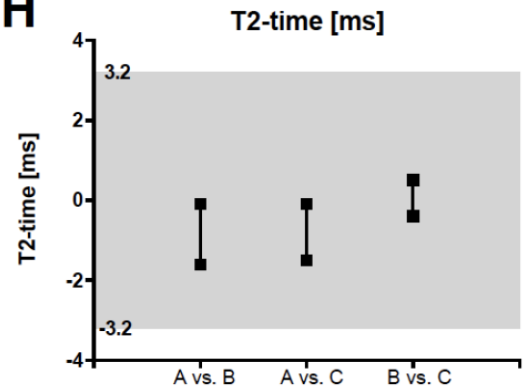
Example: Impact of different Software



exceeding tolerance range



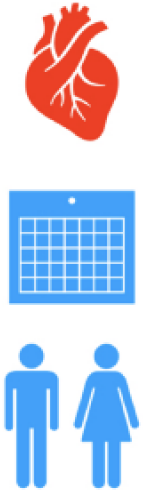
H



Zange et al JCMR 2019

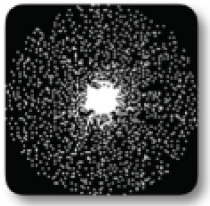
Pathway of Artificial Intelligence - Influence on Precision?

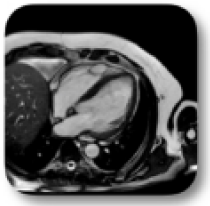
Indication & Patient Scheduling



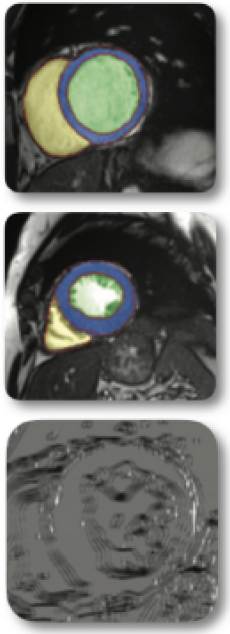
Acquisition

Image Reconstruction & Image Quality

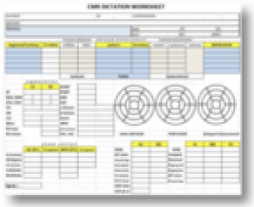




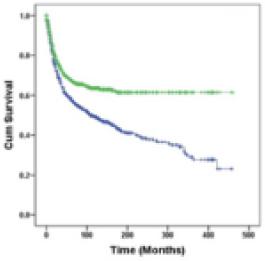
Segmentation, Quantification & Radiomics



Classification & Reporting

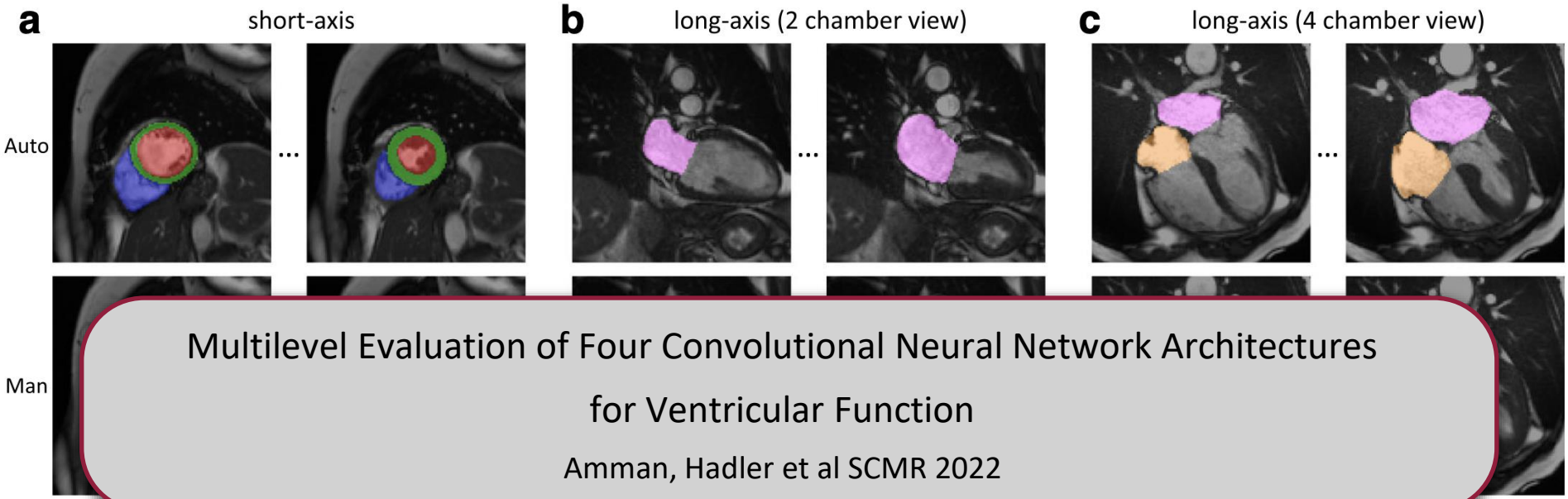


Prognosis



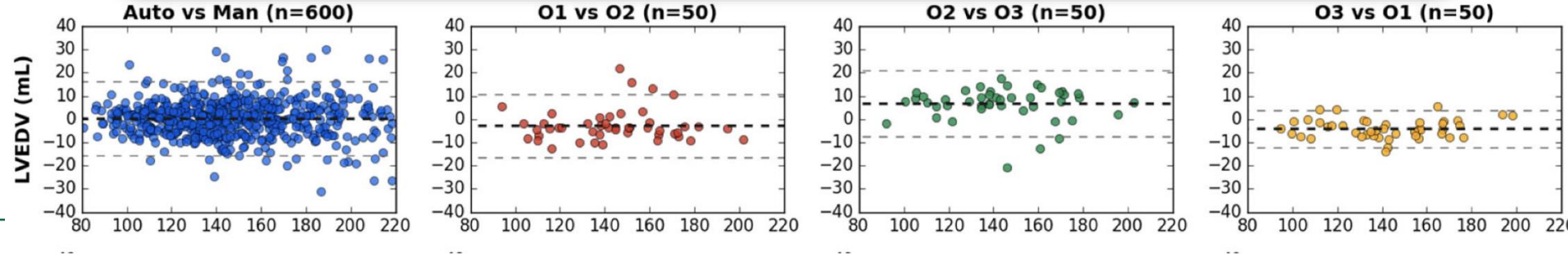
Leiner et al JCMR 2019

Bai *et al. Journal of Cardiovascular Magnetic Resonance* (2018) 20:65



Multilevel Evaluation of Four Convolutional Neural Network Architectures for Ventricular Function

Amman, Hadler et al SCMR 2022



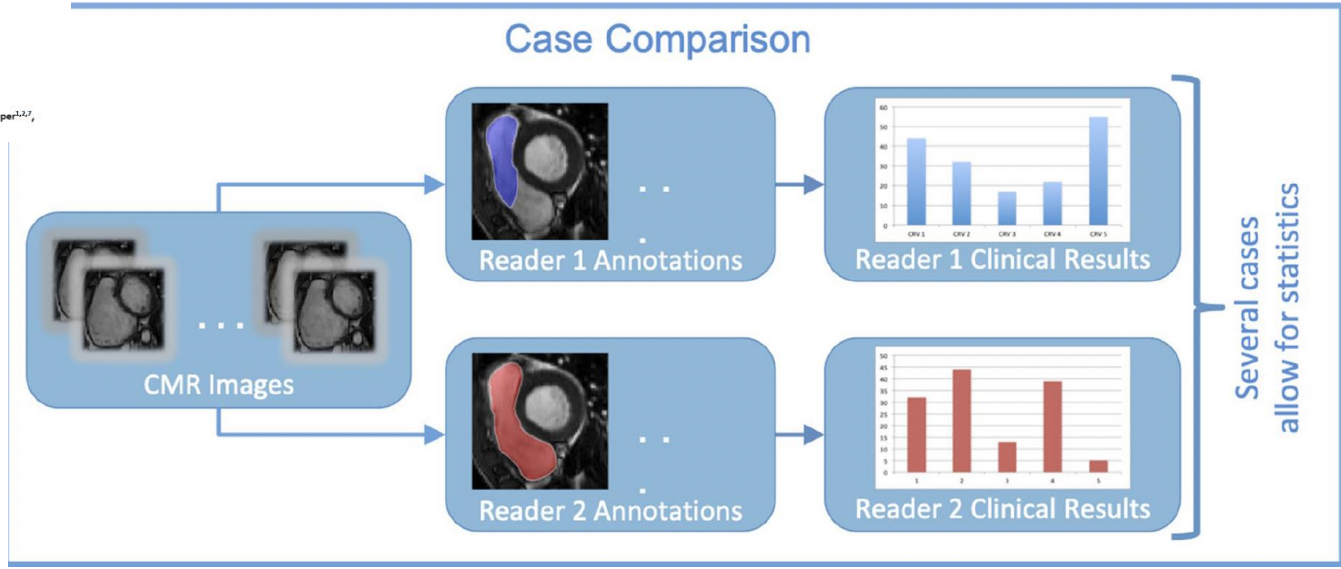
Lazy Luna: Quality Control - Postprocessing

scientific reports

OPEN

Introduction of Lazy Luna an automatic software-driven multilevel comparison of ventricular function quantification in cardiovascular magnetic resonance imaging

Thomas Hadler[1,2,3], Jens Wetzl[5], Steffen Lange[6], Christian Geppert[5], Max Fenski[1,2], Endri Abazi[1,2], Jan Gröschel[1,2,3], Clemens Ammann[1], Felix Wenson[1,2,3], Agnieszka Töpper[1,2,7], Sascha Däuber[5] & Jeanette Schulz-Menger[1,2,3,4]

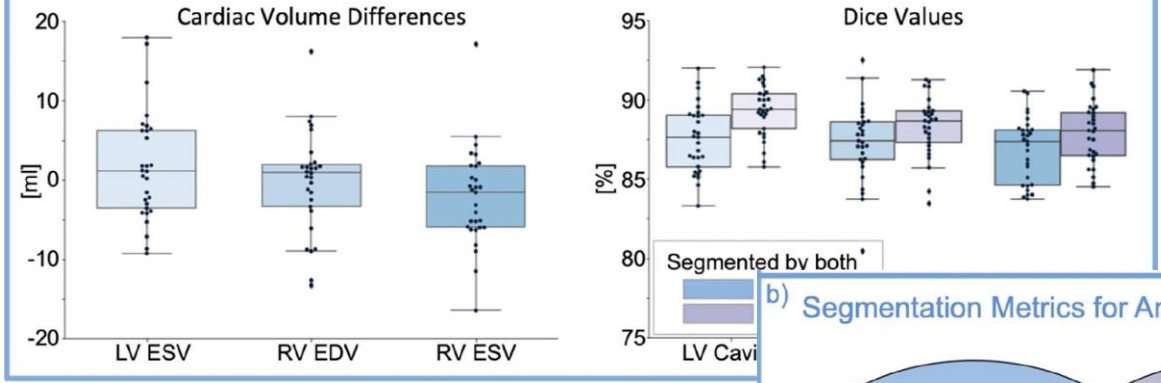


Hadler et al Sci Report 2022

Lazy Luna: Quality Control - Postprocessing

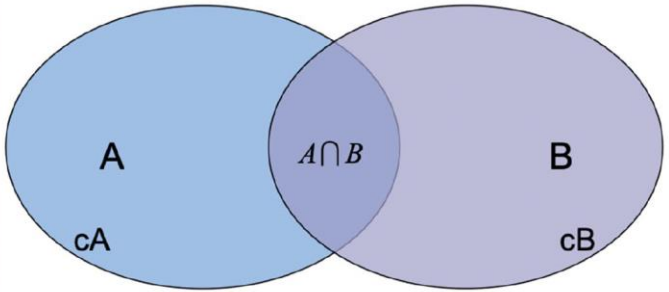
c)

Statistical Comparison of Readers



b)

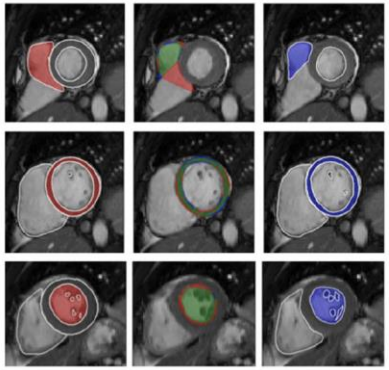
Segmentation Metrics for Annotation Comparison



$$Dice(A,B) = \frac{2 \times |A \cap B|}{|A| + |B|}$$

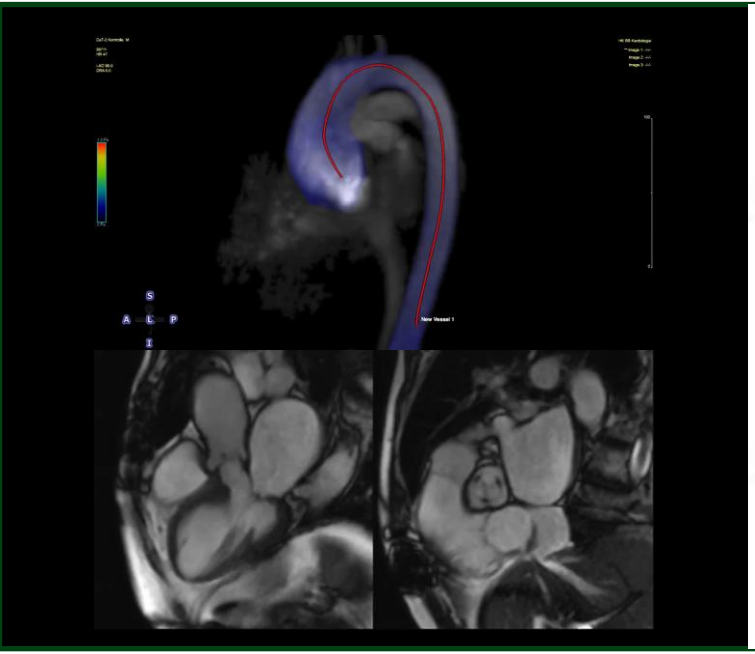
$$HD(A,B) = \max\{max_{a \in cA}(\min_{b \in cB} d(a,b)), max_{b \in dc}(\min_{a \in cA} d(a,b))\}$$

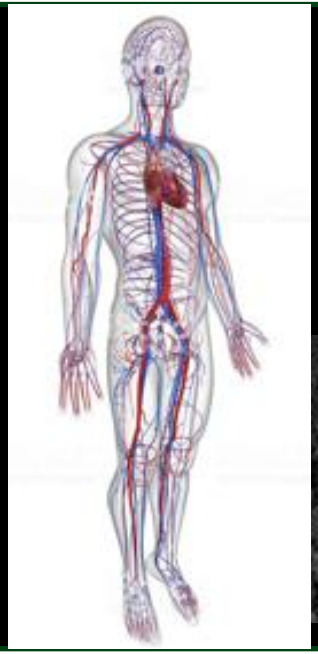
Qualitative Comparison

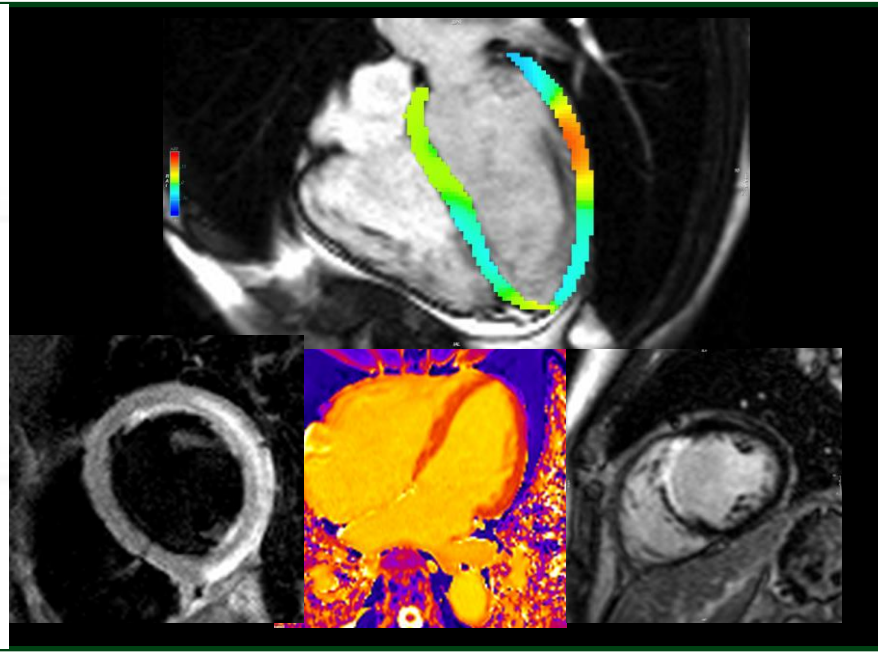


Hadler et al Sci Report 2022

Interaction







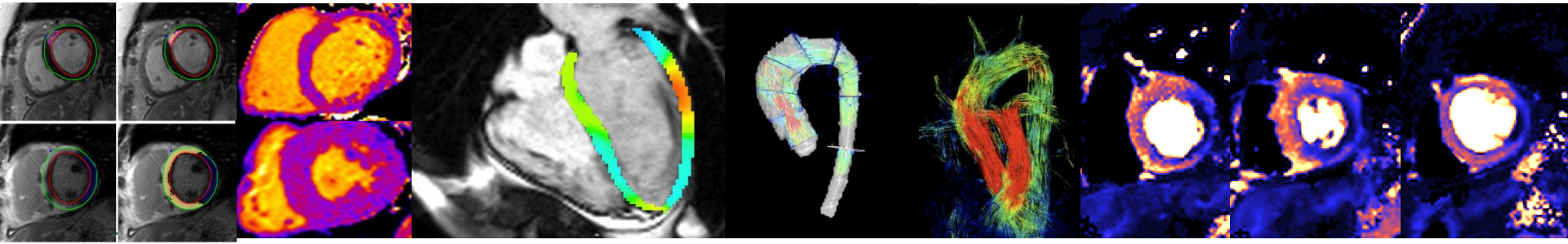
hemodynamics

myocardial structure

Stock-Fotografie-ID:153121983

CMR Postprocessing –clinical practice and unmet needs

- Quantification means biomarker diagnosis and therapy guiding
- Need - <u>precise</u> techniques
- Responsibility for quality assurance



AG CMRA puzzle needs a lot of power and patience

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Thomas Hadler (BioQIC)
Felix Krüger (BioQIC)
Chiara Manini (BioQIC)
Simone Hufnagel (BioQIC)
Leily Riazy, Dr. (Charité)
Darian Viezzer (Charité)

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C. Geppert and Team (Siemens, Erlangen)
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D. Enniz (UCLA, LA)
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S. Weingaertner (Delft)

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Carolin Lim
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Max Müller