MRI of ARVD

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Disclosures

- Off-label: gadolinium MRI of the heart
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Arrhythmogenic RV Dysplasia

- MRI is the most important noninvasive imaging tool to evaluate ARVD
- Performance of the MRI is best done at centers very familiar with cardiovascular MRI
- Second opinions for this disorder are considered standard at many practices because the disease is rare

MRI protocol for suspected ARVD

1. Axial / short axis “T1” images, blood suppression
   - 5 mm slice thickness
   - Anterior coil, FOV 24-28
2. Axial T1, with fat suppression
3. Cine: axial and short axis
4. Delayed “viability” axial and short axis images after 0.2 mmol/kg gadolinium

MRI is only 1 part of ARVD diagnosis:

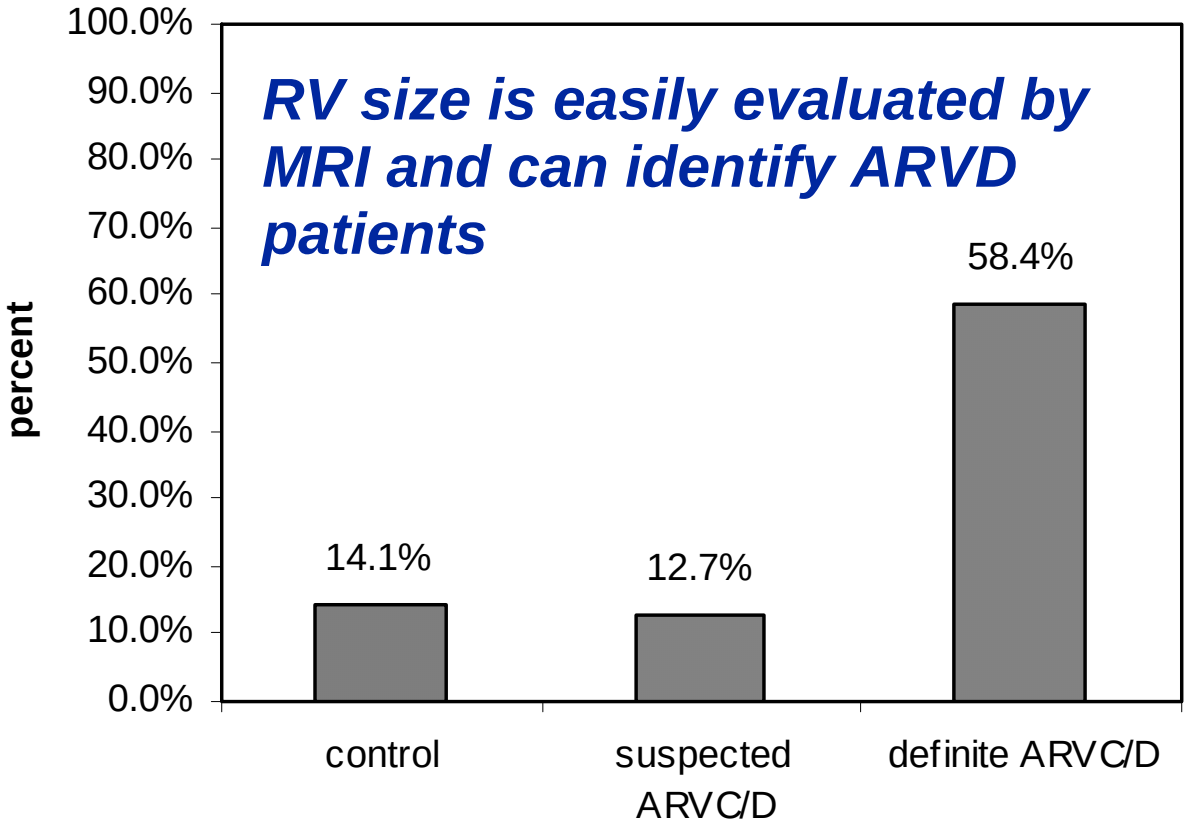
Criteria	Major
Abnl structure/ function by echo, ventriculography, MRI or nuclear	Severe dilatation and reduction of RV EF Localized RV aneurysms Severe segmental dilatation of RV
ECG Repolarization or depolarization/ abnormalities	T wave inversions QRS prolongation Epsilon waves
Arrhythmias	
Family history	Confirmed at necropsy or surgery

Br Heart J 1994:71

Morphologic abnormalities in ARVD

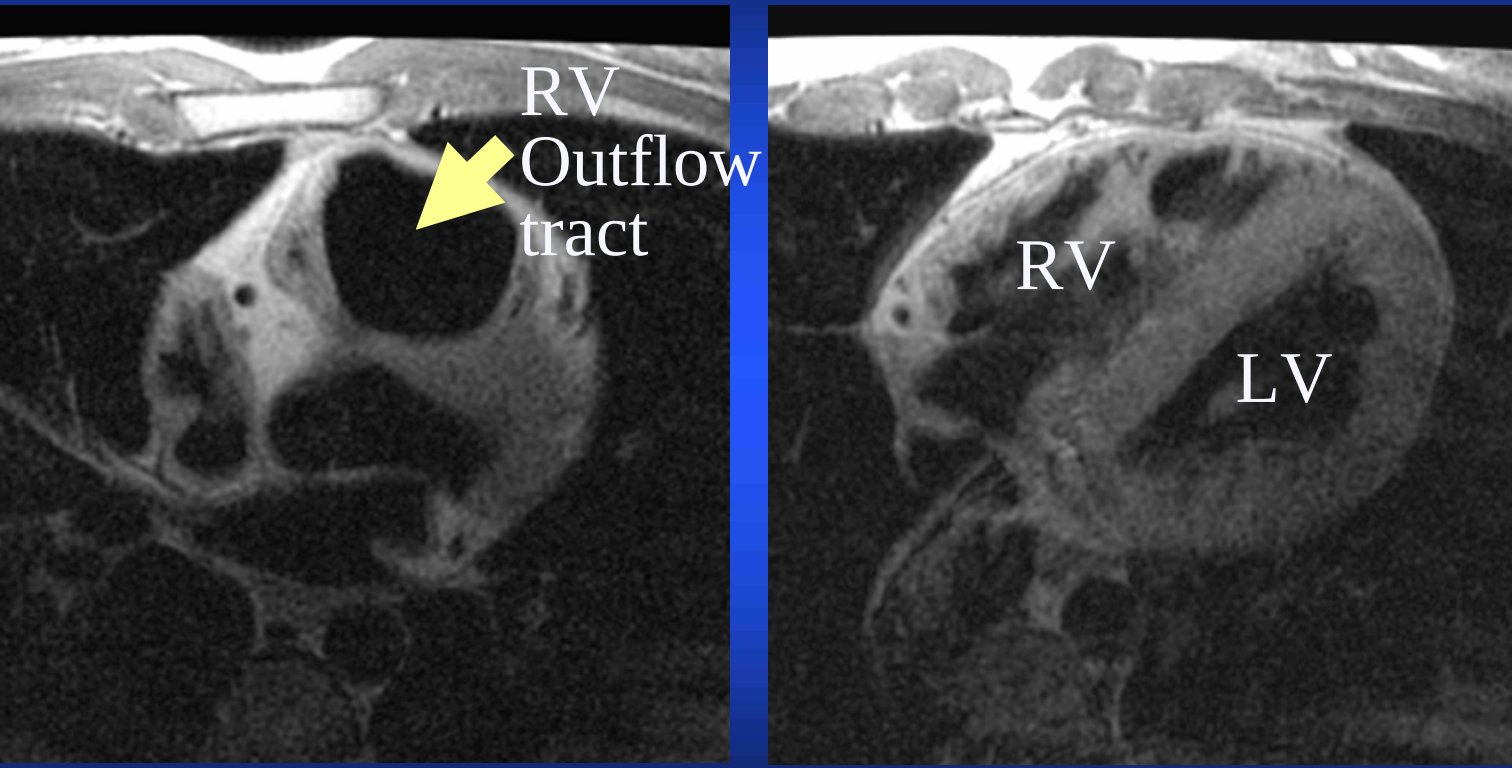
- Right ventricular enlargement
- RV volumes are normally equal to or less than the LV
- RV end diastolic diameter is normally equal to or less than the LV

Presence of RV chamber enlargement



Bluemke et al., Cardiology, 2003:99;153

ARVD: Example of RV enlargement



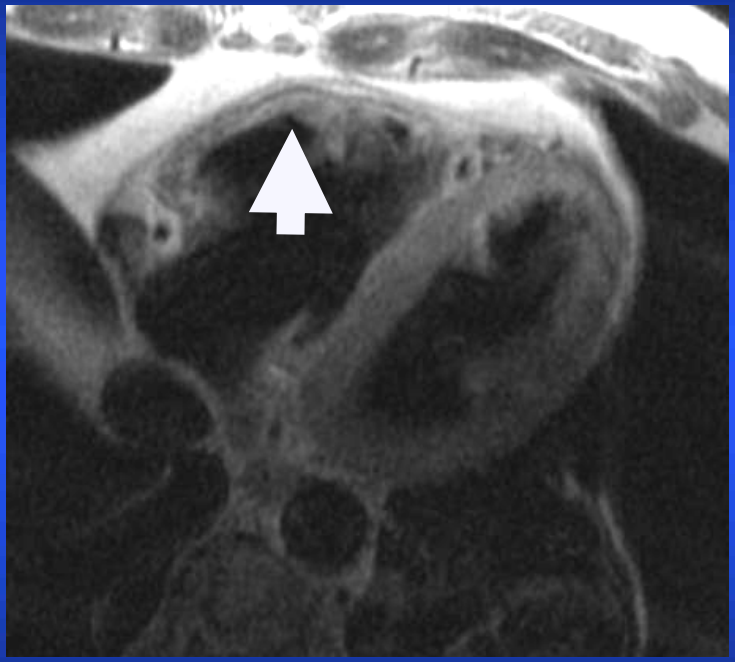
Axial T1 weighted images

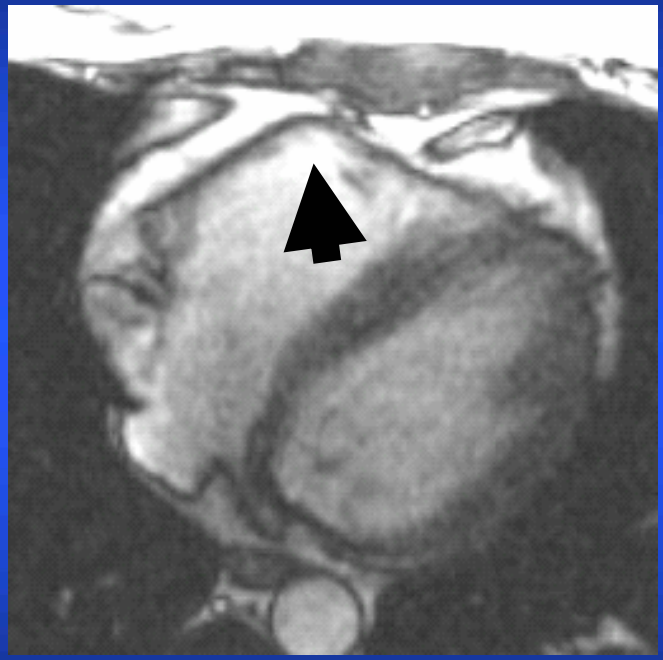
Functional abnormalities of the RV useful for diagnosis of ARVD by MRI

Cine MRI can detect:

1. Regional or global wall motion abnormalities
2. Focal aneurysms

Right ventricular aneurysm



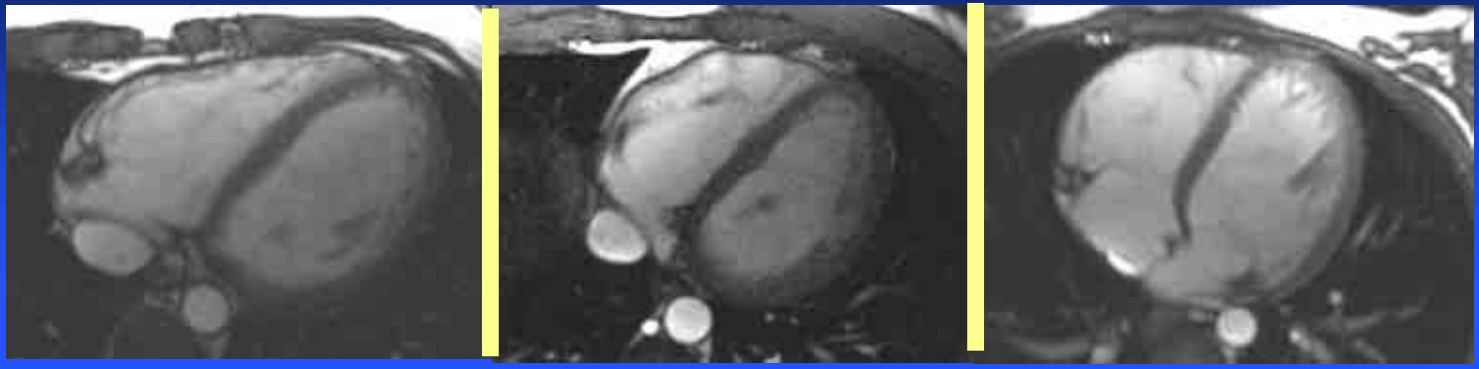


T1 image (left) and cine image (right) show small aneurysm in the anterior wall (arrow). These are more easily seen in cine motion studies.

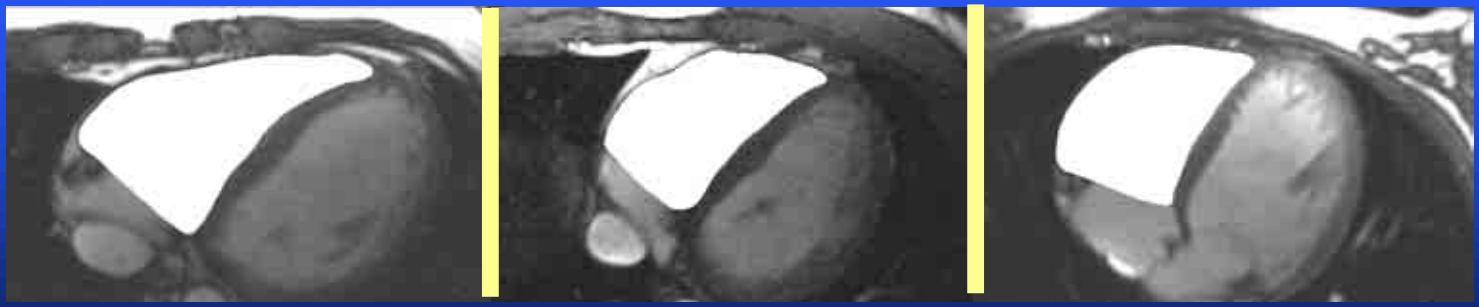
Assessment of RV function by MRI for ARVD

- A common potential pitfall on MRI is misdiagnosis of wall motion abnormality in the RV.
- 93% of normal RV's have small motion abnormalities, usually around the moderator band.
- The shape of the RV is highly variable as seen on axial MRI (next slide)

Normal RV shape varies axial images



Fritz et al., SCMR 2005, poster 467



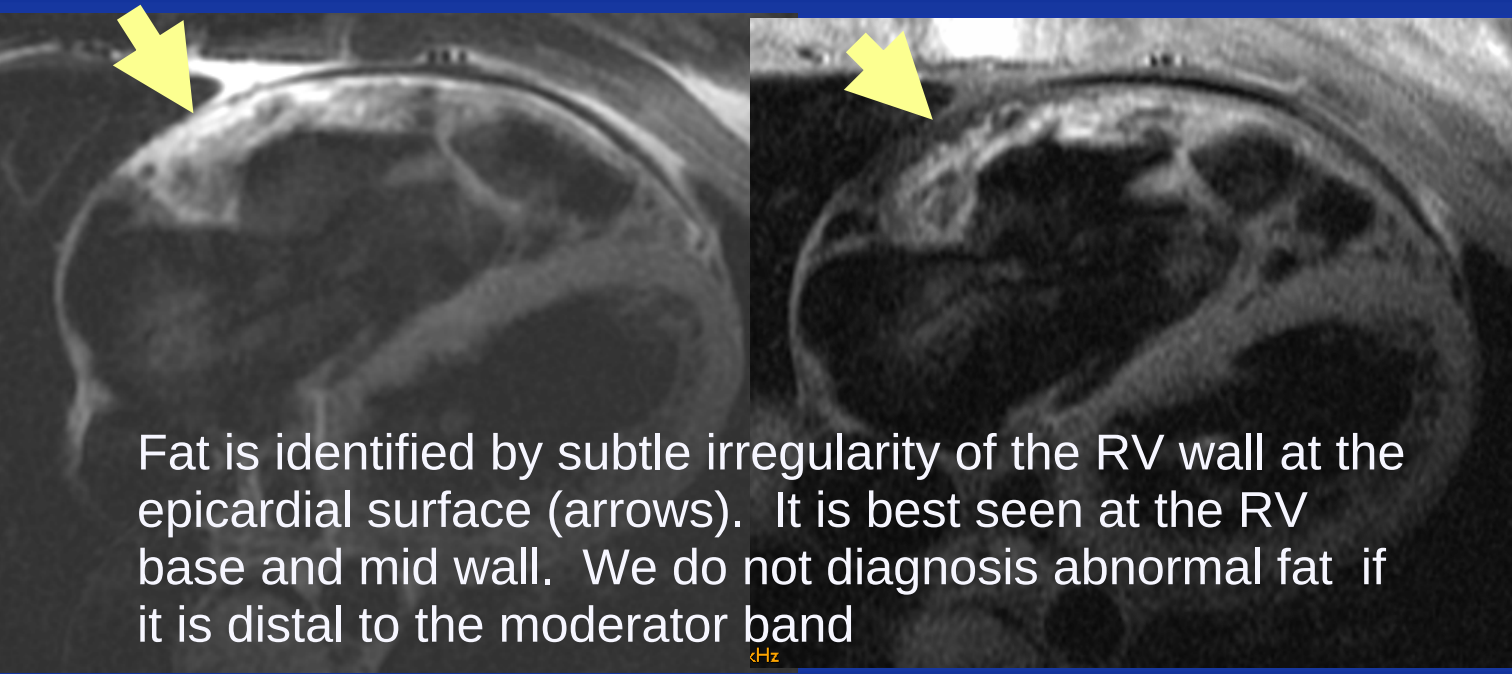
Wedge, 17% of normal volunteers

box 37% – **round 33%**

Fatty infiltration of the RV by MRI

- MRI identification of fat is **not** strictly a McKenna criteria (*fibrofatty tissue only by endomyocardial biopsy*). However, RV fat is commonly looked for and reported by MRI.
- Unfortunately, MRI (and CT) resolution is only sufficient to detect large amounts of RV fat.
- Fat is present in the NORMAL RV and is usually overdiagnosed by MRI. In our experience, wall motion abnormalities must also be present in order to diagnosis ARVD.

MRI of RV fat

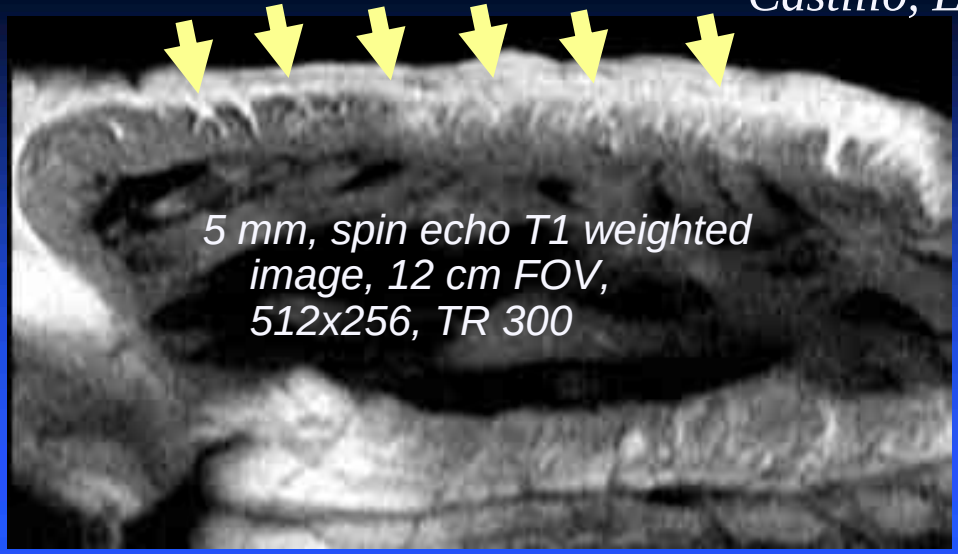


Fat is identified by subtle irregularity of the RV wall at the epicardial surface (arrows). It is best seen at the RV base and mid wall. We do not diagnosis abnormal fat if it is distal to the moderator band

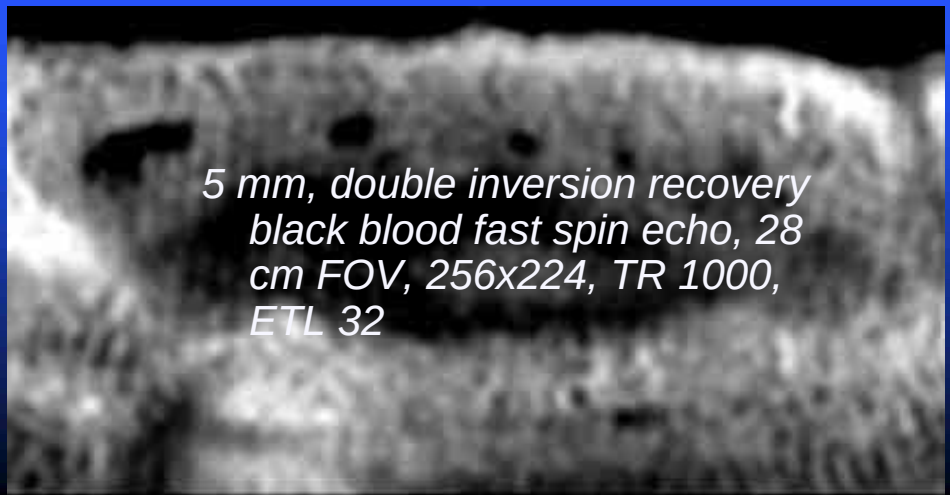
T1 image

T1 image with fat suppression

Castillo, E., et al Radiology, 2004



At the top is an MRI of an autopsy specimen of a patient who died from ARVD. This resolution is not possible to obtain for patient studies. Fat (arrows) is shown as white signal. This infiltrates the epicardial surface of the RV.



At the bottom is the same specimen imaged using a typical MRI pulse sequence in 15 seconds. The fat details are quite blurred.

Fat in the RV is not specific for ARVD

- MRI detects can detect macroscopic fat infiltration; however, fat alone is not specific for ARVD:

  >40% fibrous tissue, >3% fat,
  < 45% residual myocytes.

- The use of gadolinium enhanced MRI can detect inflammation and/or fibrosis.

Fibrofatty tissue by MRI

Cardiac Magnetic Resonance

Noninvasive Detection of Myocardial Fibrosis in Arrhythmogenic Right Ventricular Cardiomyopathy Using Delayed-Enhancement Magnetic Resonance Imaging

Harikrishna Tandri, MD,* Manoj Saranathan, PHD,† E. Rene Rodriguez, MD,* Claudia Martinez, MD,* Chandra Bomma, MD,* Khurram Nasir, MBBS,* Boas Rosen, MD,* João A. C. Lima, MD,* Hugh Calkins, MD,* David A. Bluemke, MD, PHD*†

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JACC 2005; 45

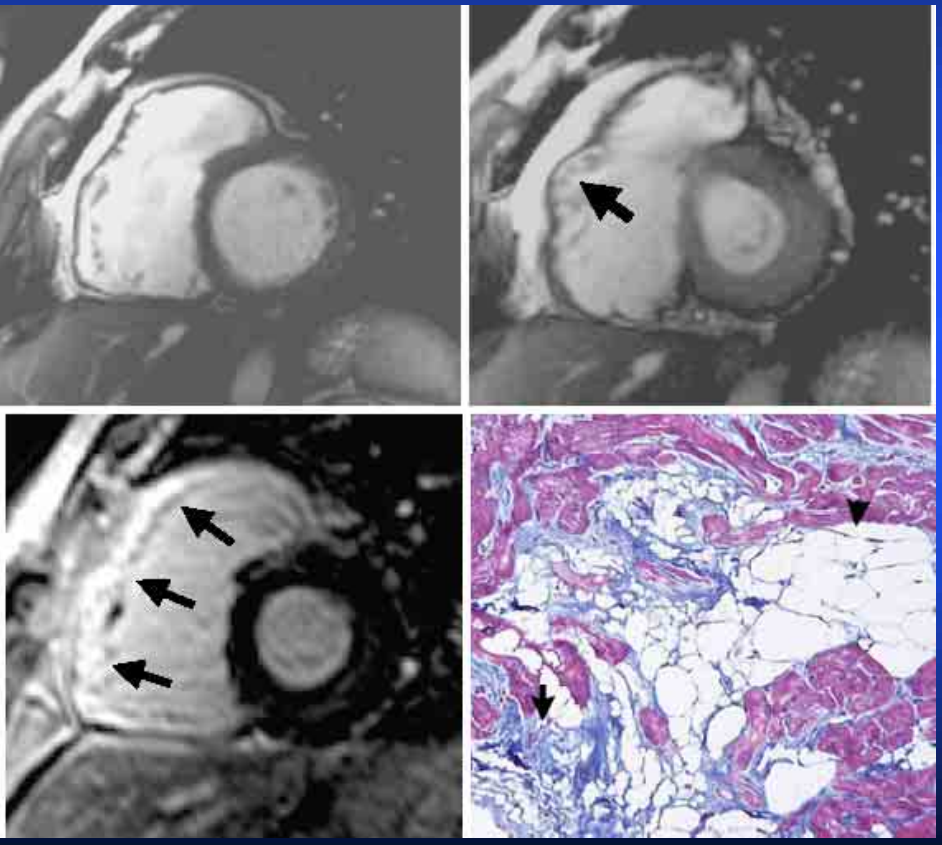
We have recently presented the results of gadolinium enhanced MRI for diagnosis of fibrosis for diagnosis of ARVD. We believe this is an additional tool to improve the specificity of MRI for ARVD diagnosis.

Delayed Gadolinium Enhancement

- Similar technique to MRI “viability” imaging
- 0.2 mmol/kg gadolinium administered. Imaging is 10-20 minutes later. Inversion times (TI) are set to null normal myocardium (TI 175-250 msec)
- Delayed enhancement present in 8/13 (61%) of ARVD patients.
- 7 patients had biopsy, all showed fibrosis.
- All of patients had other RV abnormalities (wall motion, morphology)

Tandri, JACC 2005; 45

Delayed enhancement correlates with myocardial fibrosis in ARVD



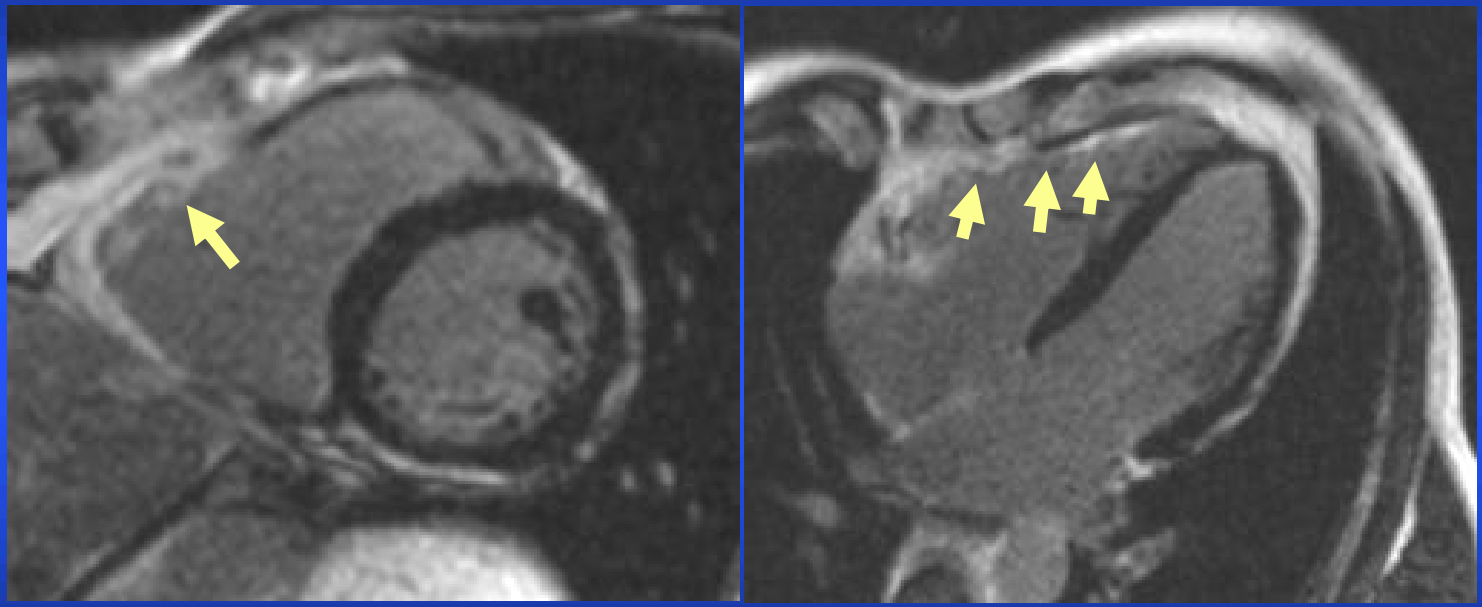
Top left: end diastole cine MRI

Top right: end systole cine MRI showing aneurysm at the arrow

Bottom left: arrows show gadolinium enhancement of the RV

Bottom right: collagen (blue, arrow) on the biopsy specimen. Fat cells are evident

Right ventricle delayed enhancement by MRI



Short axis (left) and axial (right) delayed gadolinium images. Enhancement of the RV is shown at the arrows in this patient meeting diagnostic criteria for ARVD

Primary differential diagnosis: RVOT

Findings on Magnetic Resonance Imaging of Idiopathic Right Ventricular Outflow Tachycardia

Harikrishna Tandri, MD, David A. Bluemke, MD, PhD, Victor A. Ferrari, MD, Chandra Bomma, MD, Khurram Nasir, MD, Julie Rutberg, MS, Crystal Tichnell, MGC, Cynthia James, PhD, João A.C. Lima, MD, and Hugh Calkins, MD

(Am J Cardiol 2004;94:1441–1445)

RVOT is the main differential diagnosis for ARVD. In this publication, we found no difference in morphology and function of the right ventricle for RVOT patients compared to normal volunteers.

Summary: ARVD

- MRI is the best noninvasive method to evaluate RV function and morphology *and fibrofatty tissue*.
- MRI findings must be considered with respect to other McKenna criteria.

ARVD.COM

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