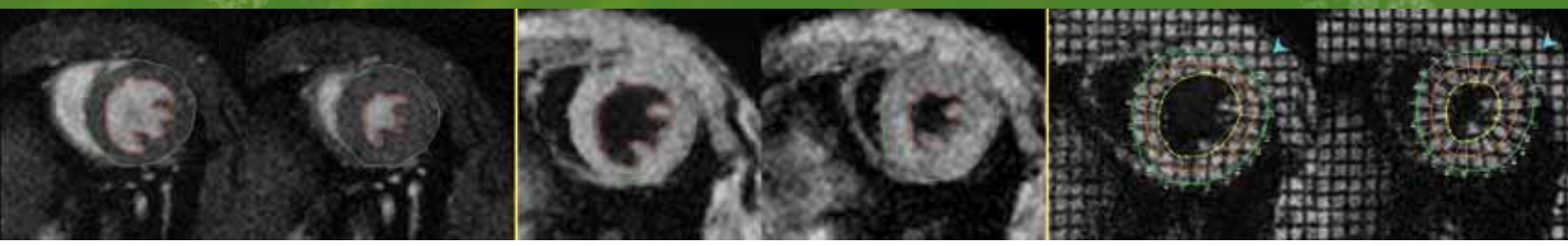
Agilent nScope eMRI Applications for Pre-Clinical Research

ACCESSIBLE MRI METHODS: ULTRA-HIGH FIELD MOUSE CARDIAC MRI

The Measure of Confidence



Agilent Technologies

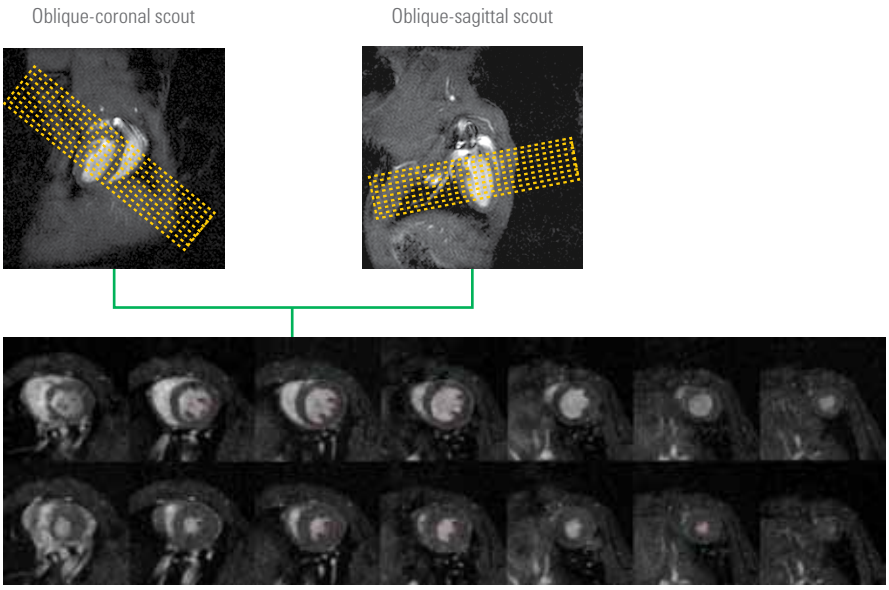
ASSESS CARDIAC MORPHOLOGY AT ULTRA-HIGH FIELDS WITH OPTIMIZED PROTOCOLS

Designed for novice and expert pre-clinical researchers, the Agilent nScope eMRI provides sequences developed for characterizing small animal models of cardiac diseases using ultra-high magnetic fields. It includes a Cardiac Pack that makes it easy to collect and manipulate data for the assessment of cardiac morphology and cardiovascular indices.

- Superior image quality in short acquisition times despite the challenges posed by small heart size and rapid heart rates found in rodents
- Simultaneous cardiac and respiratory gating option with steady state maintenance (double-gating) to tackle severe breathing artifacts
- Accurate evaluations of global cardiac function and mass, myocardial wall deformations, and viability with a single pulse sequence

Global Ventricle Function and Ventricle Mass in a Few Simple Steps

The Agilent nScope eMRI with Cardiac Pack helps you to obtain accurate and reproducible measurements of global cardiac function for phenotyping and quantitatively evaluating animal models obtained with surgical or transgenic techniques. All you need is a cardiac-gated fast spoiled gradient-echo sequence, and a collection of slices covering the heart from the base to the apex in the short axis view (See Cardiac Piloting). Next, you can outline endocardial and epicardial contours on end-diastolic and end-systolic frames using the aid of semi-automatic software to calculate the parameters shown in the table below.



Short axis multi-slice views. End-diastolic (Upper) and end-systolic (Lower row) frames are shown for all slices covering the heart from base (Left) to apex (Right). Agilent Tagcine sequence, Resolution=234 x 234 μm^2 (zero-padded to 117 x 117 μm^2), slice thickness=1 mm, FA=15°, TR/TE=5ms/1.2ms, 3 averages.

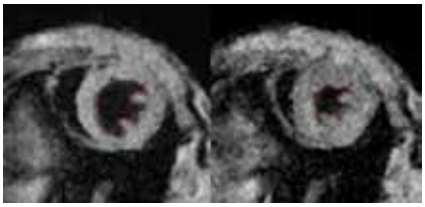
Global Cardiac Function and Mass Results on Healthy Control

Description	Acronym	Value
End Diastolic Volume	EDV	61 µl
End-Systolic Volume	ESV	22 µl
Stroke Volume	SV=EDV-ESV	39 µl
Ejection Fraction	EF=SV/EDV*100	64 %
Heart Rate	HR	545bpm
Cardiac Output	CO=SV*HR	19.5 mil/min

Improved Endocardial Definition and Myocardial Tagging

Black-Blood Cine

With the Agilent Cardiac Pack you can use a double inversion pulse prior to acquiring the cine loop for black-blood imaging. A first non-selective pulse inverts the magnetization of all spins in the body, and then a second slice-selective IR pulse re-inverts only the spins in the image slice. Images are acquired following an inversion time that allows inverted blood spins outside the slice to reach the null point, suppressing the signal from the blood. While more time consuming than a bright-blood image, the black-blood cine sequence can produce images with improved endocardial border definition by eliminating flow artifacts.

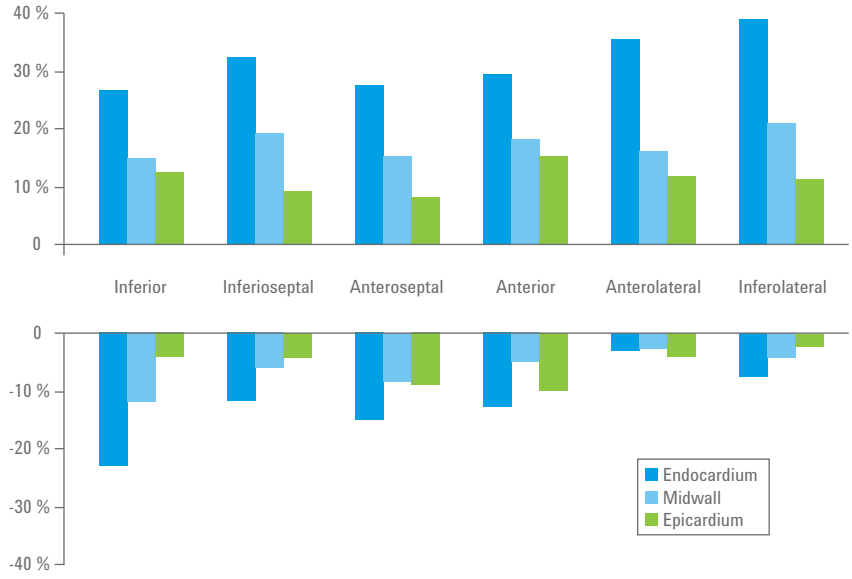


Diastolic (left) and systolic (right) frames from a mid-ventricular slice. Parameters include the Agilent Tagcine sequence, resolution = 234 x 234 μm^2 (zero-padded to 117 x 117 μm^2), slice thickness=1 mm, FA=20°, TR/TE = 5.4 ms/1.9 ms, 3 averages.

Tagging Cine

The tagging pulse sequence in the Cardiac Pack spatially modulates myocardial magnetization using a sinc-modulated RF pulse train (Wu Ed X *et al.,* MRM, **2002**, 48:389-393). This produces an intensity saturation profile which is similar to an ideal rectangular profile. With the Agilent nScope eMRI, tagging imaging can be combined with black-blood preparation to improve endocardial border definition.

Diastolic (left) and systolic frames (right) frames from a mid-ventricular slice. Parameters included the Agilent Tagcine sequence, resolution = 156 x 156 μm^2 (zero-padded to 117 x 117 μm^2), slice thickness = 1mm, FA = 20°, TR/TE = 5.0 ms/2.3 ms, Tag spacing 700 μm, 4 averages.



Maximal and minimal circumferential strains.

Acknowledgments

1. Images are provided courtesy of King's College London and have been acquired using the following magnet specifications: 7T, with a 205/120 gradient set (60 Gauss/cm – 200 us rise time), Tx/Rx volume coil (39 cm inner diameter)

2. Global LV function was quantified using Segment v1.9 R2046 (http://segment. heiberg. se), E. Heiberg *et al.,* Design and Validation of Segment – a Freely Available Software for Cardiovascular Image Analysis, *BMC Medical Imaging,* **2010**, 10:1.

3. Tagging data were analyzed by Dr Martina Marinelli, Cardiovascular MR Unit, Fondazione G. Monasterio CNR-Regione Toscana, Pisa, IT using HARP® software by Diagnosoft Inc.

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