Parametric map of myocardial perfusion

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The Abstract

Purpose/Introduction: First-pass cardiac MR perfusion imaging was initially
performed only with 1 or 2 slices. With increasing performances of MR scanners due
to stronger gradients, and new temporal sampling strategies, 2D multi-slice whole
coverage of the heart has been enabled. This, however, increases the data flow to be
analyzed. The standard manual ROI-based perfusion analysis getting more time-
consuming on an increasing quantity of data raises the interest of an automated data
analysis method. In this study we present a pixel-wise, semi-automated and user-
independent cardiac perfusion analysis method.
Methods: Eight patients with a history of myocardial infarction and no acute
symptoms were included in this study. Infarction was detected in 5 patients by Tl-
SPECT used as reference. MR Imaging was carried out on an Philips Eclipse 1.5T
MR system with an RF-FAST sequence and following parameters: TI/TR/TE
28/3.74/1.5 ms, 50 kHz bandwidth, 40° FA, 90°-180° preparation pulses, 112×128
matrix, mean FOV 37 cm (±2 cm). A cardiac surface coil and ECG trigger were used.
Eight slices were acquired during three to six cardiac cycles, depending on patient's
heart rate. A bolus of 0.08 mmol/kg Gd-DTPA was injected in a brachial vein at 0.5
ml/s injection rate followed by 10 ml of isotonic saline with a Medrad Spectris MR
injector. Central short axis slices were chosen for the analysis. A motion correction
algorithm was first applied, using IDL 5.5. LV cavity was segmented manually for the
arterial input function, and k_1, k_2 flow-related blood-tissue transfer coefficients were
calculated automatically in each pixel solving the one compartment model equation:
$dC_{myo}(t)/dt = k_1 C_{art}(t) - k_2 C_{myo}(t)$
In the k_1 maps obtained, pixel values were averaged in myocardial regions of interest
(ROI), two per following sectors: anterior, lateral, inferior and septal, corresponding
to the segmentation used in the Tl-SPECT images.
Results: In 40 analyzed sectors, 12 were infarcted and 38 normal. A 20% (±11)
variability was found in normal sectors (s.d./mean per patient, $p > 0.38$), and a 45%
(±24) reduction of k_1 was found on average in infarcted regions ($p < 0.03$). The
variability found in normal regions does not exceed variability reported in literature
with manual ROI definition.
Discussion/Conclusion: This study shows the feasibility of a semi-automatic,
parametric, cardiac perfusion analysis. Despite initial limits such as spill-over
contamination from the cavity, and difficult distinction of the endocardial wall due to
partial volume, a hypo-perfusion was detected in the infarcted areas. The algorithm
presented here accelerates the myocardial perfusion analysis procedure.