DUAL CONTRAST K-EDGE RENAL PERFUSION USING SPECTRAL PHOTON-COUNTING CT

INITIAL EXPERIENCE

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 643694

DISCLOSURES

Nothing to disclose:	**Salim Si-Mohamed**
Nothing to disclose:	Gabrielle Normand
Nothing to disclose:	Daniel Bar-Ness
Nothing to disclose:	Sandrine Lemoine
Nothing to disclose:	Laurent Juillard
Nothing to disclose:	Loic Boussel
Nothing to disclose:	Monica Sigovan
Nothing to disclose:	Philippe Douek

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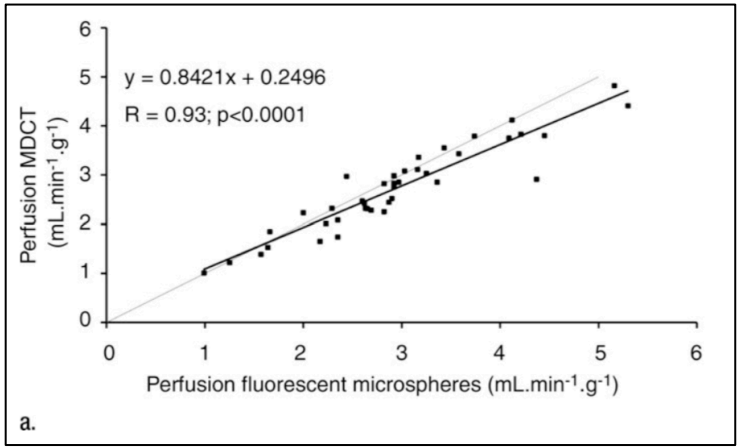
SPCCT
IMAGING ALL THE PHOTONS

INTRODUCTION

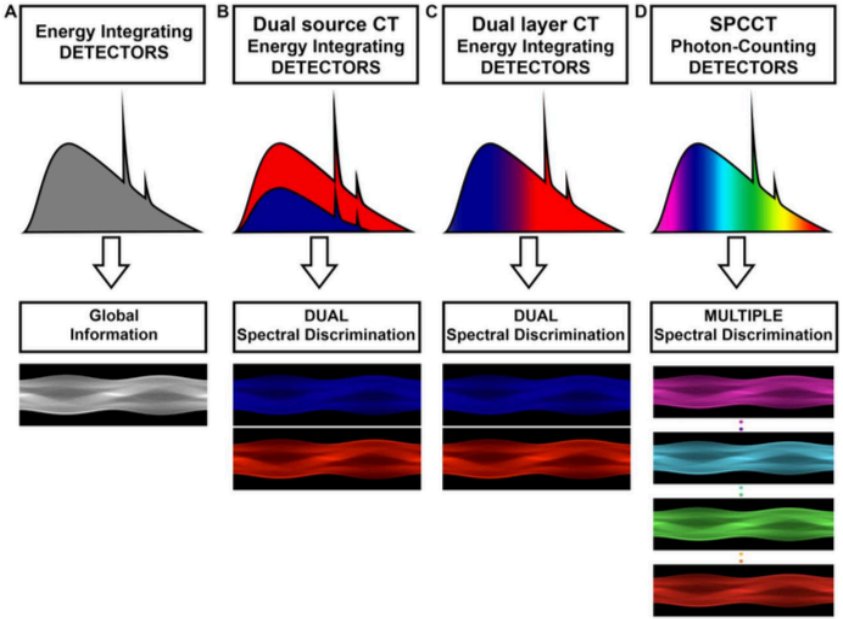
- Renal perfusion
  - essential functional parameter for evaluating renal vascular damage
  - validation of a MDCT renal perfusion method using iodine based media contrast [(1)]
- BUT Drawbacks of iodine media contrast
  - hypersensitivity to iodinated agents
  - contra-indicated for use in patients with moderate renal insufficiency (<30 ml/min)



[(1)] *Lemoine et al. Radiology. 2012*

INTRODUCTION

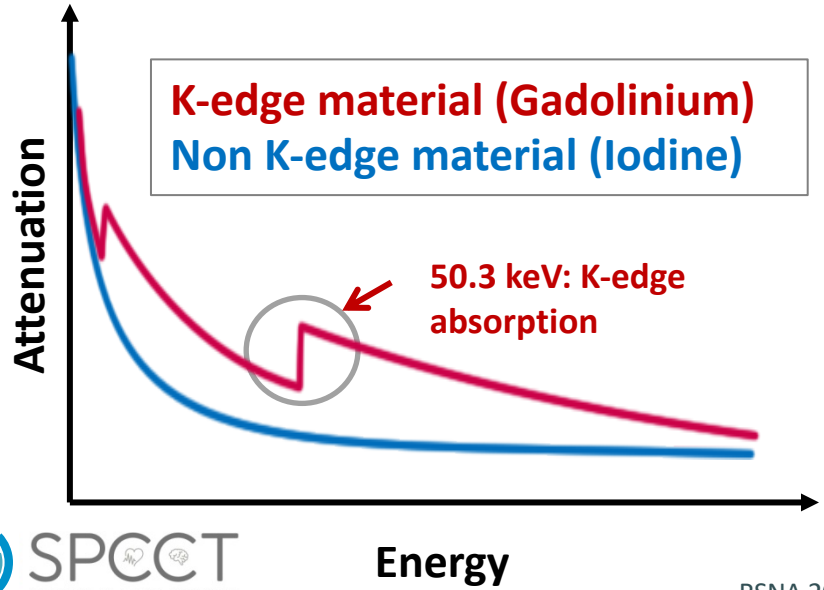
- Spectral photon-counting computed tomography (SPCCT) technology
  - New and promising imaging modality
  - Development of energy resolving detectors called photon-counting detectors [1]
    - **K-edge imaging**
    - **Dual contrast imaging**
  - Improved intrinsic spatial resolution [1]



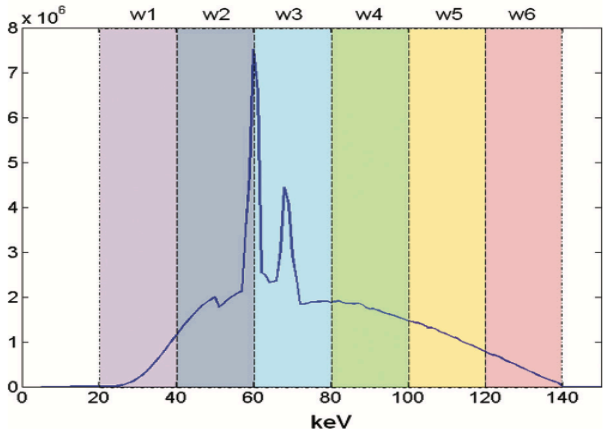
[1] Si-mohamed et al. NIMAA. 2017

BACKGROUND

- "K-edge imaging"(1)
  - ex: Gadolinium



- Advantages
  - Material specific K-edge imaging
  - Absolute quantification of specific materials



(1) Mc Collough. Radiology. 2015

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OBJECTIVE

To investigate the feasibility of the SPCCT to assess renal perfusion using gadolinium K-edge maps and iodine maps in comparison with HU conventional images as reference.

MATERIALS/METHODS

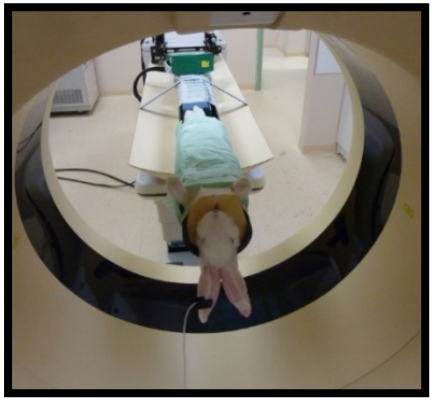
- Spectral photon-counting CT system (SPCCT)
  - 5 bins photon-counting detectors system

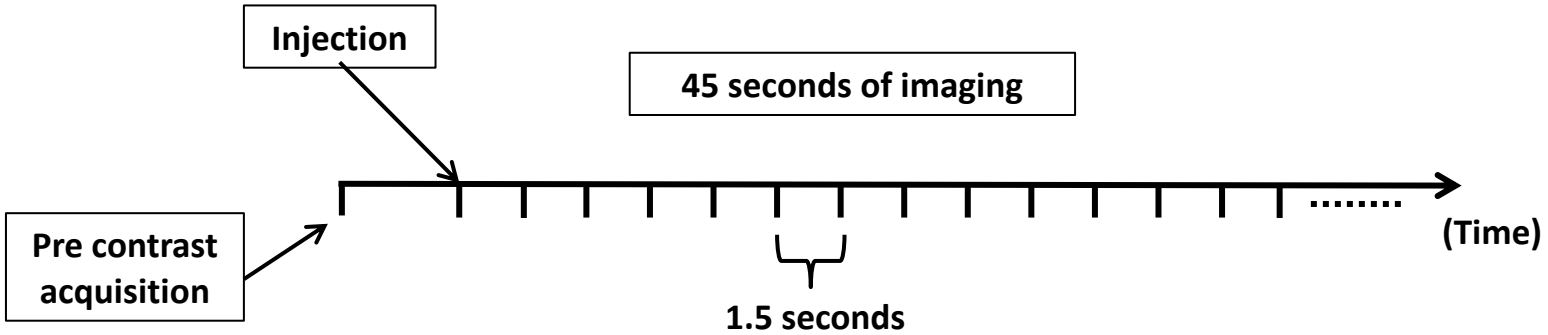
  => thresholds set as 30, 51, 64, 72, 85 keV
  - Conventional X ray tube with a field of vue of 160 mm
  - **Spatial resolution: 250 µm**
  - Parameters used:
    - Tube current of 100 mAs
    - Tube voltage of 120 kVp

Philips Spectral Photon Counting CT pre-clinical prototype UCBL, CERMEP, Lyon, France

MATERIALS/METHODS

- Dynamic renal perfusion imaging
  - 4 rabbits (3.5 kg±0.3)
  - **Simultaneous** injection of:
    - Macrocyclic gadolinium based contrast agent (0.5 mmol/ml, 3 ml/kg, Dotarem, Guerbet)
    - Iodine based contrast agent (400 mg/ml, 1 ml/kg, Iomeron, Bracco)
    - at 3 mL/sec
  - Similar pharmacokinetics expected





SPECT IMAGING ALL THE PHOTONS

MATERIALS/METHODS

- Under 2 conditions: baseline and dopamine infusion (10 µg/kg/min-30 min)

- Renal perfusion was calculated on gadolinium and iodine maps and HU images using **a validated gamma variate model** (1)

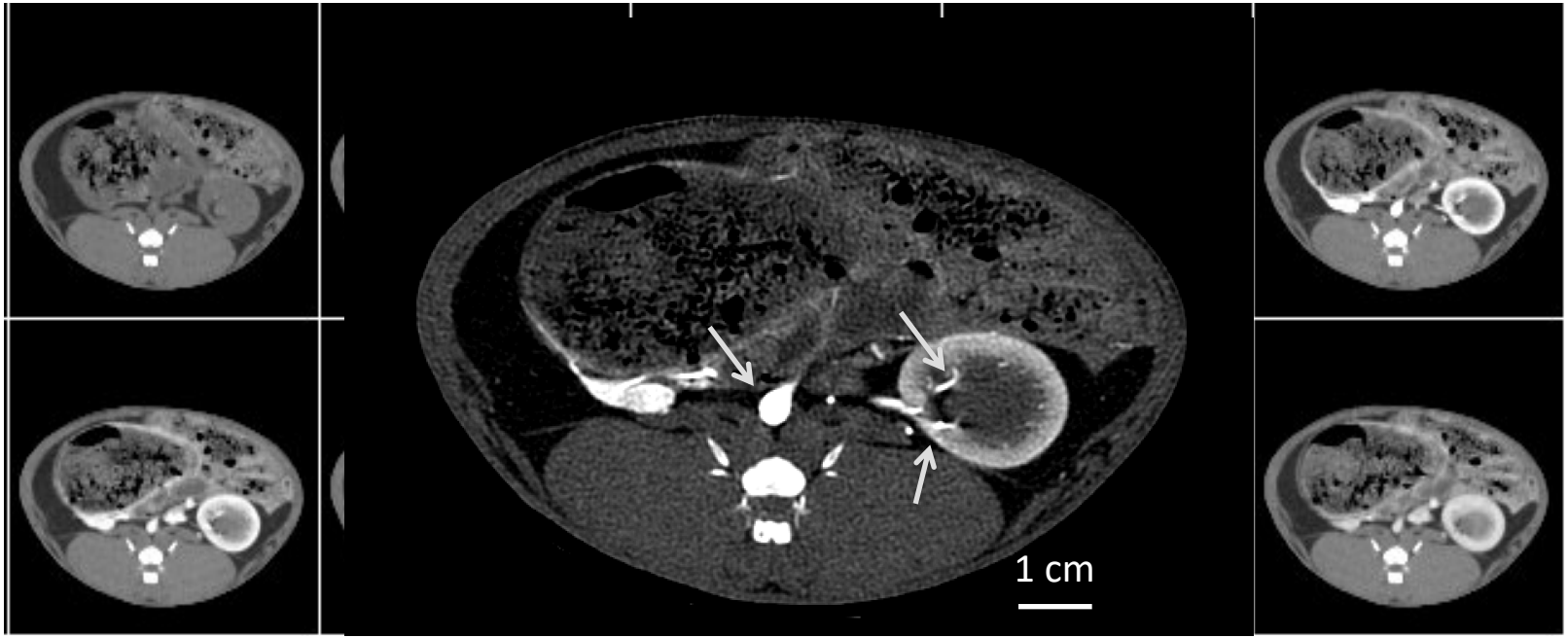
- Statistical analysis:
  - Values of renal perfusion on gadolinium and iodine maps were compared to HU images using the least squares regression analysis
  - Changes in parameters before and after dopamine infusion were compared using a Wilcoxon signed-rank test

(1) *Krier et al. Am J Physiol Renal Physiol 2001*

SPECT
IMAGING ALL THE PHOTONS

RESULTS

Conventional HU images



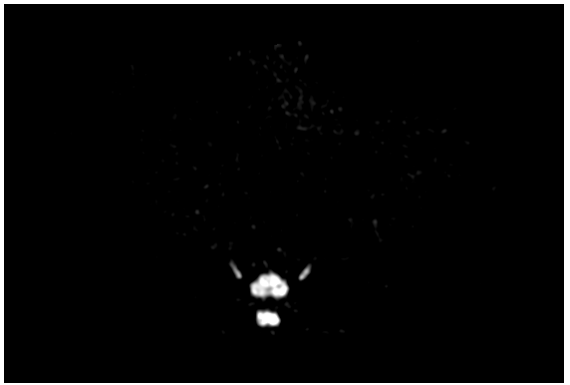
RESULTS

Conventional HU images and contrast material maps

Conventional HU images

Gadolinium maps

Iodine maps



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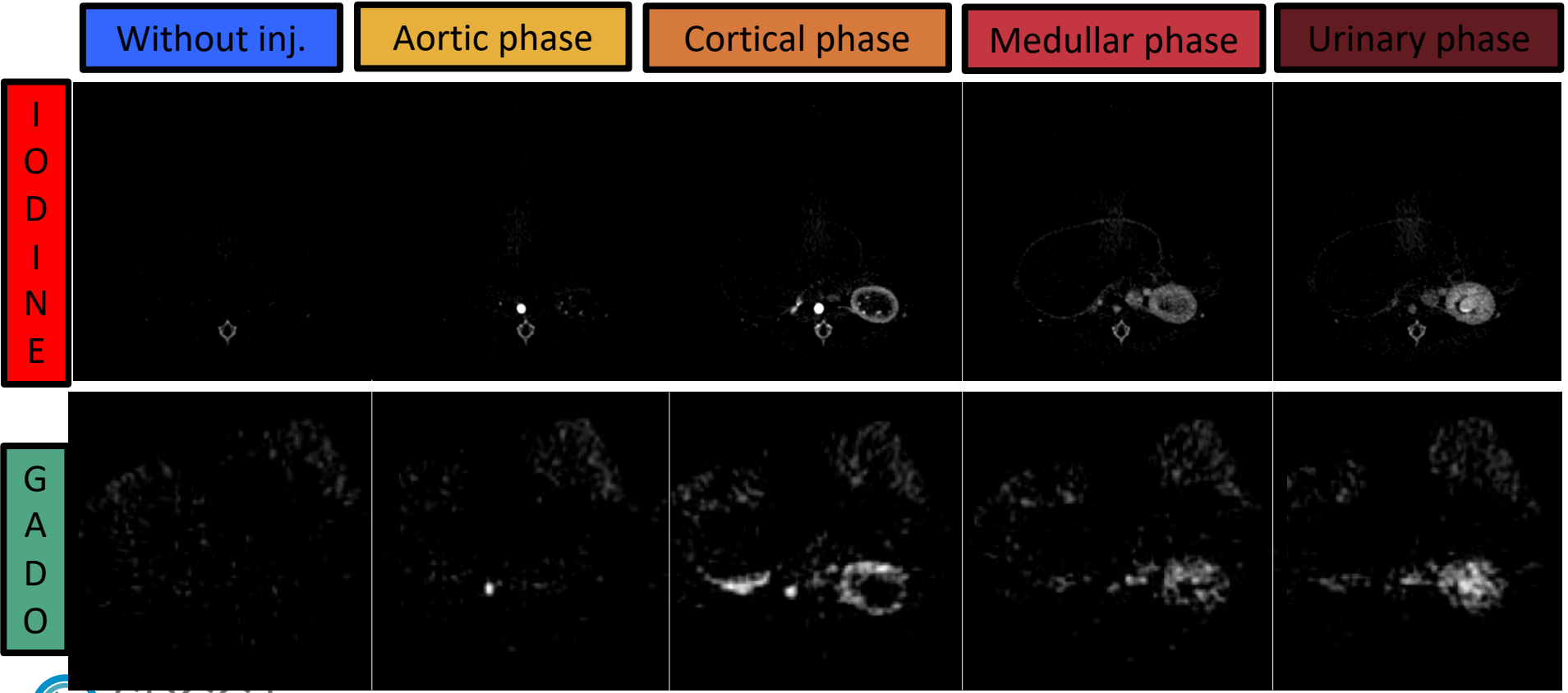
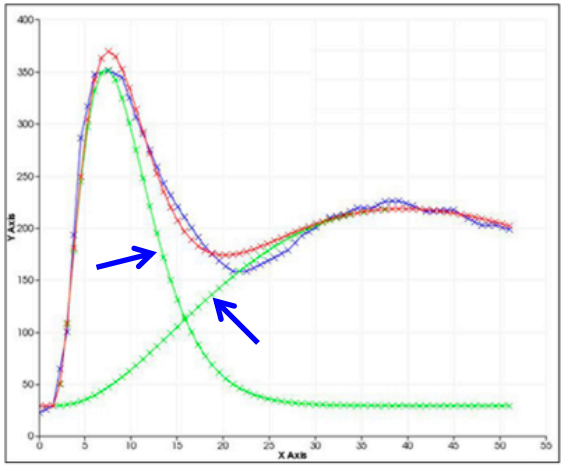
MULTIPHASE DUAL CONTRAST IMAGING

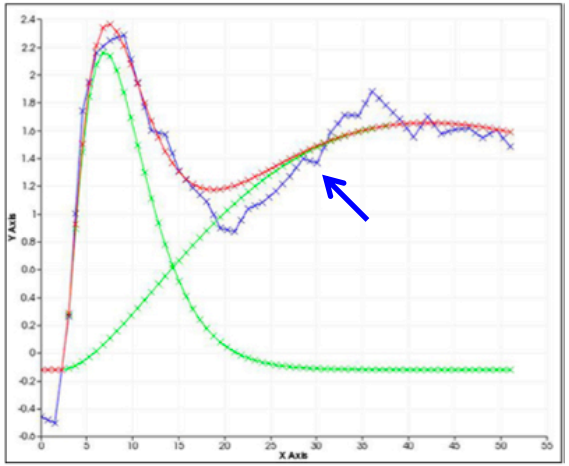


RESULTS

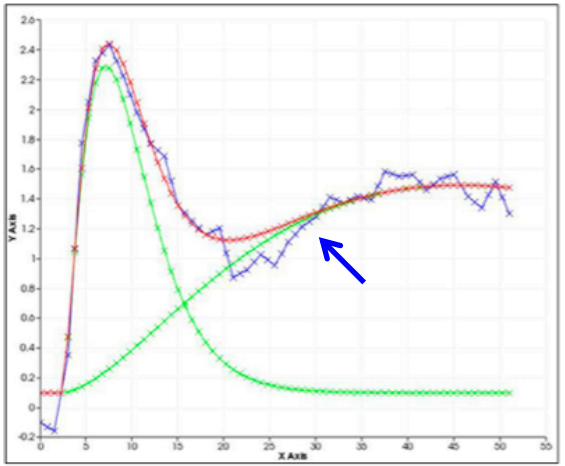
Modelisation with conventional CT images

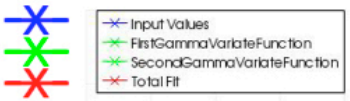


Modelisation with iodine images



Modelisation with gadolinium images





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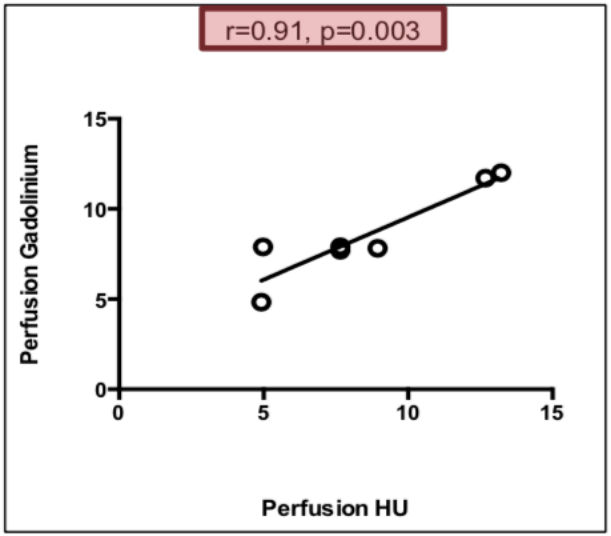
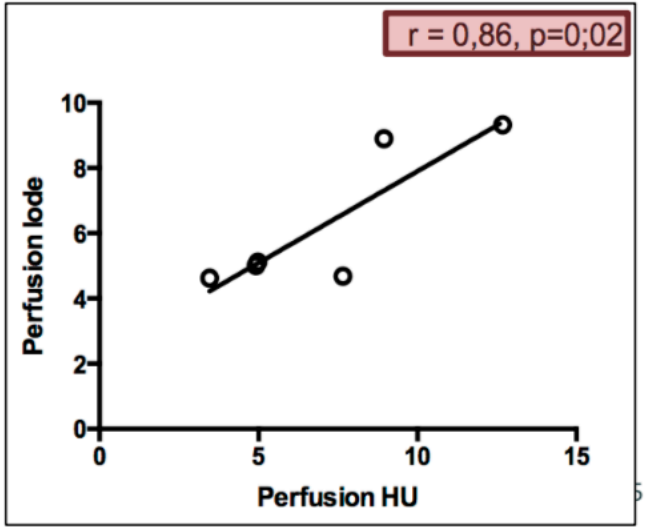
RESULTS

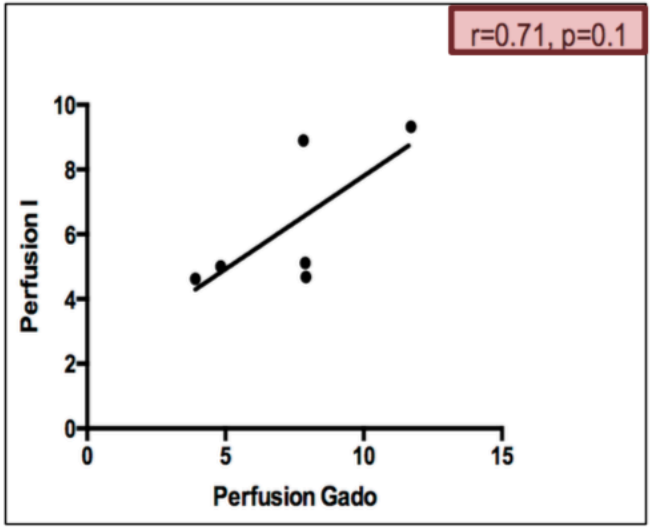
Correlation between HU and Gadolinium images



Correlation between HU and iodine mages



Correlation between gadolinium and iodine images



*units: ml/min/g

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CONCLUSION

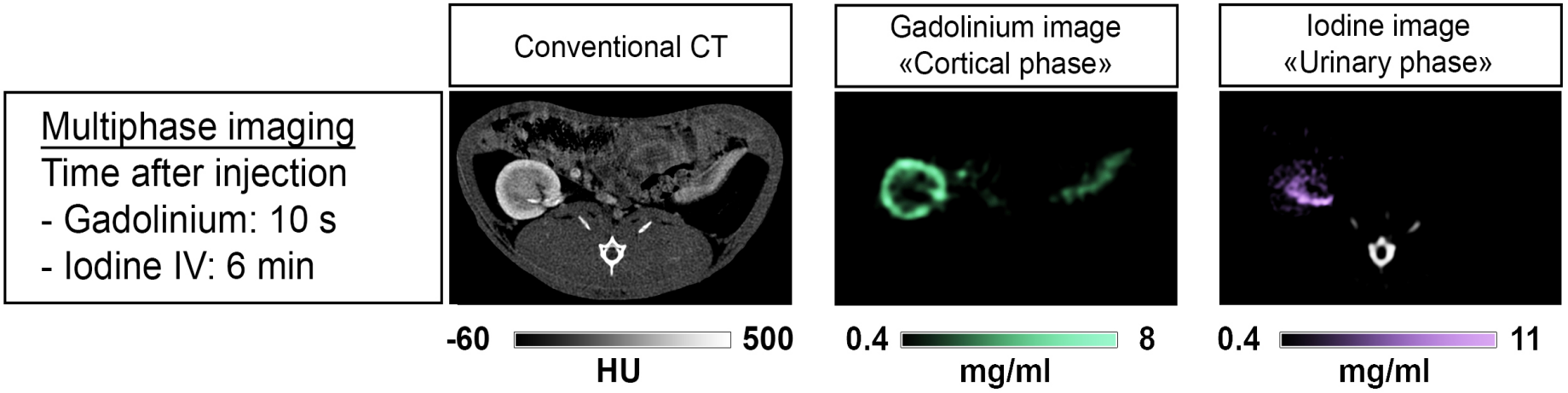
- High spatial resolution (250 µm)

- High spectral resolution
  - Discrimination of the contrast agents
  - Accuracy of the renal perfusion parameters using K-edge imaging

PERSPECTIVES

- Great interest to diagnose and prevent the evolution of numerous conditions responsible for a low renal perfusion toward vascular nephropathies, first of them being the renal artery stenosis

- Multiphase biphasic dual contrast imaging in order to reduce number of acquisitions



THANK YOU FOR ATTENTION

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Funding from the European Union's Horizon 2020 No 643694.