DYNAMIC IODINE AND GADOLINIUM K-EDGE KIDNEY PERFUSION IMAGING USING SPECTRAL PHOTON-COUNTING CT

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DISCLOSURES

Nothing to disclose: Salim Si-Mohamed

Nothing to disclose: Gabrielle Normand

Nothing to disclose: Sandrine Lemoinde

Nothing to disclose: Daniel Bar-Ness

Nothing to disclose: Monica Sigovan

Nothing to disclose: Jean Baptiste Langlois

Nothing to disclose: Loic boussel

Nothing to disclose: Laurent Juillard

Nothing to disclose: Philippe Douek

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BACKGROUND

Conventional CT

1 spectrum

E_0 average

kVp

High output scintillator

Photo Diode

Integrating ASIC

Nonopanel Elite

Spectral Dual Energy CT

1 spectrum

E_1 av E_2 av

kVp

Low density/High Light Output Scintillator

Photo Diode

High output scintillator

Photo Diode

Integrating ASIC

Nonopanel Prism

Spectral Photon Counting CT

1 spectrum

kVp

Direct Conversion Material

Counting ASIC

CZT
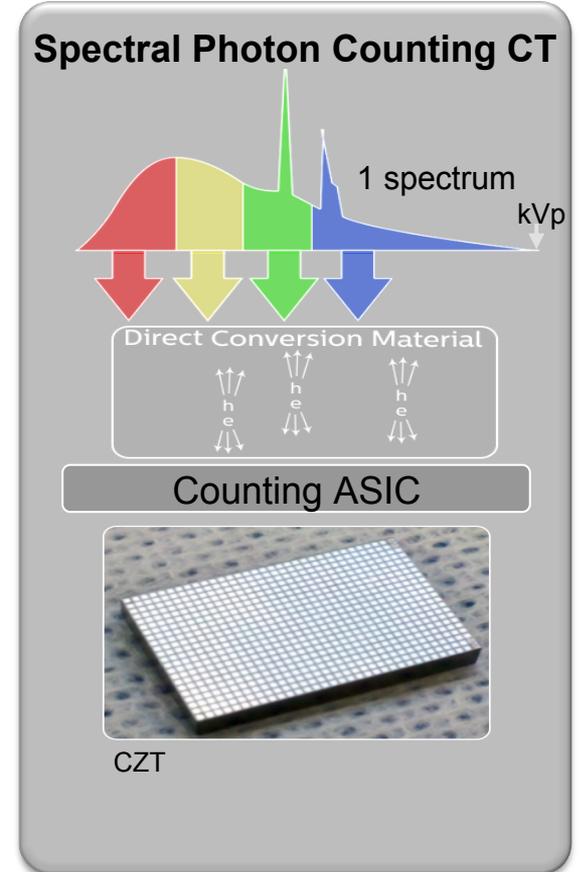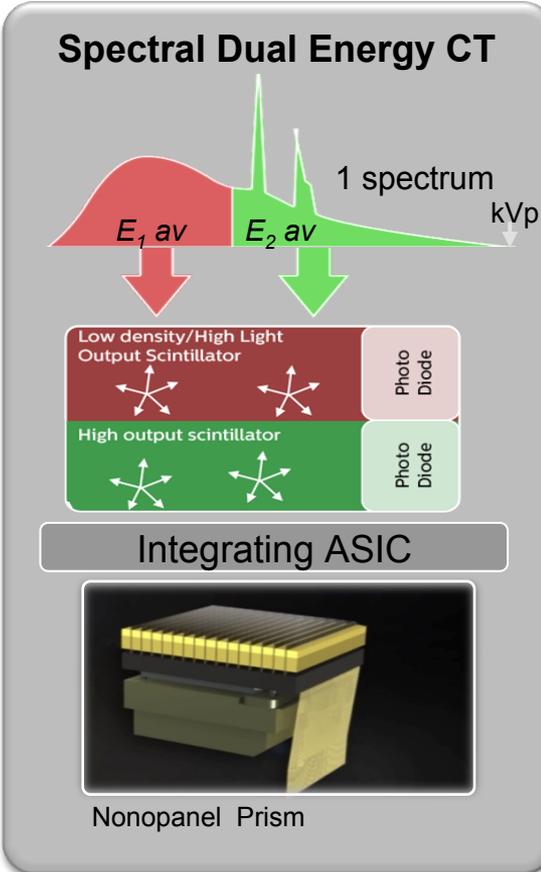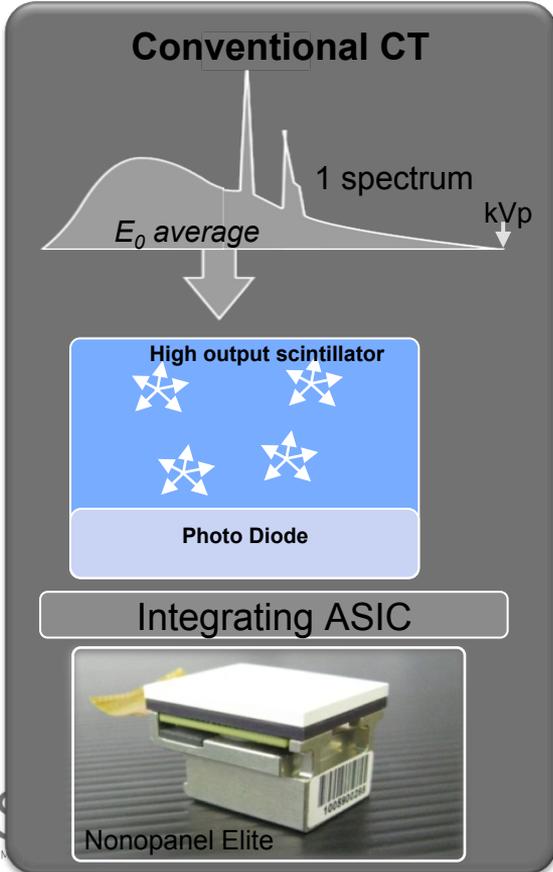
BACKGROUND

– Spectral photon-counting CT

 • Kedge imaging [1]

K-edge material
Non-K-edge material

K-edge absorption

Attenuation

Energy
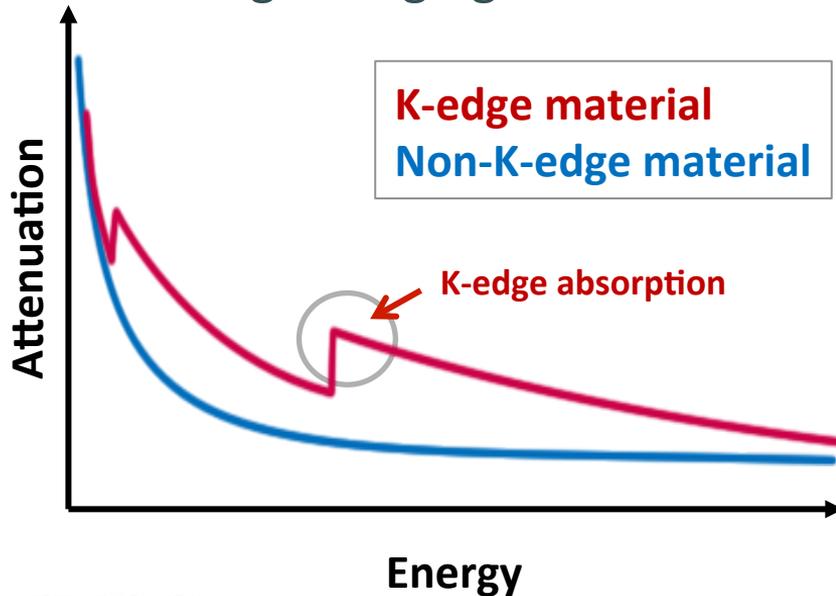
• Advantages:

 – Material specific K-edge imaging

 – Absolute quantification of specific material

(1) Schirra CO et al. Contrast Media & Molecular Imaging. 2014

BACKGROUND

– Kidney perfusion

  • Easy to perform in animal model

  • Already iodine perfusion validated in CT imaging *(1)*

– BUT Drawbacks of iodine media contrast

  • hypersensitivity to iodinated agents

  • contra-indicated for use in patients with renal insufficiency

– Gadolinium is better indicated in these cases

(1)Lemoine et al, Radiology

OBJECTIVE

To test the feasibility of the SPCCT to assess kidney perfusion using K-edge imaging of Gadolinium compared to iodine map as reference, and HU conventional images.

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MATERIAL/METHODS

– Spectral photon-counting CT system

- Photon-counting detectors
- Modified clinical base
- Conventional X ray tube
- Field of vue of 160 mm
- Gantry rotation time of 1 second
- Parameters used:
  - Tube current of 100 mAs
  - Tube voltage of 120 kVp

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

MATERIAL/METHODS

- Dynamic renal perfusion imaging
  - Simultaneous injection of:
    - Gadolinium (0.5 mmol/ml, 3 ml/kg, Dotarem, Guerbet)
    - Iodine (400 mg/ml, 1 ml/kg, Iomeron, Bracco)
  - Same pharmacokinetics expected
  - 4 rabbits
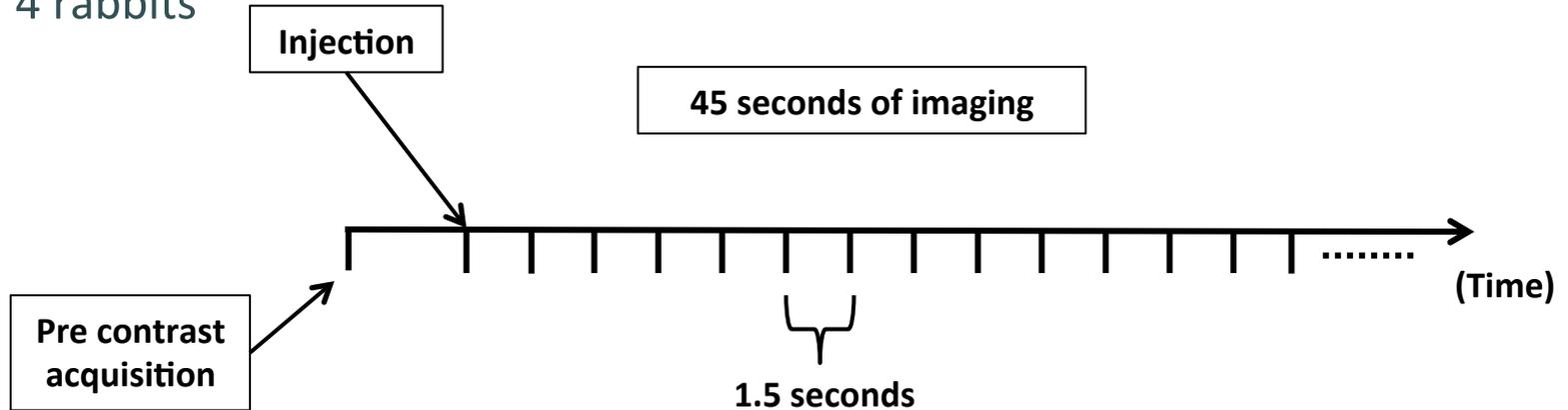
MATERIAL/METHODS

- Under 2 conditions: baseline and dopamine infusion.

- Aortic and cortical time-attenuation curves were modeled to measure renal perfusion using a validated gamma variate model

  - conventional HU

  - iodine images

  - gadolinium images

- Measurements of K-edge Gd perfusion were compared using a regression analysis with the reference method using the iodinated contrast agent injected simultaneously.

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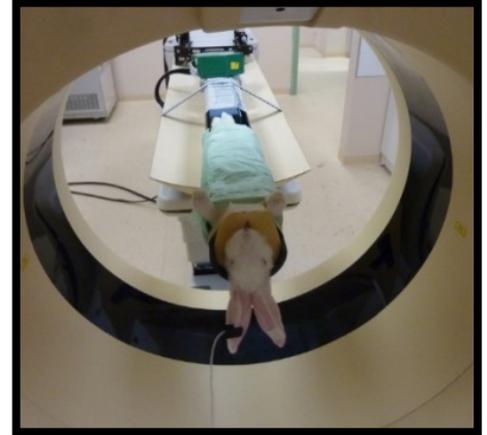
RESULTS

- SPCCT provided high spatial resolution conventional HU, specific gadolinium K-edge and iodine material decomposition images.

HU images representation of the renal perfusion
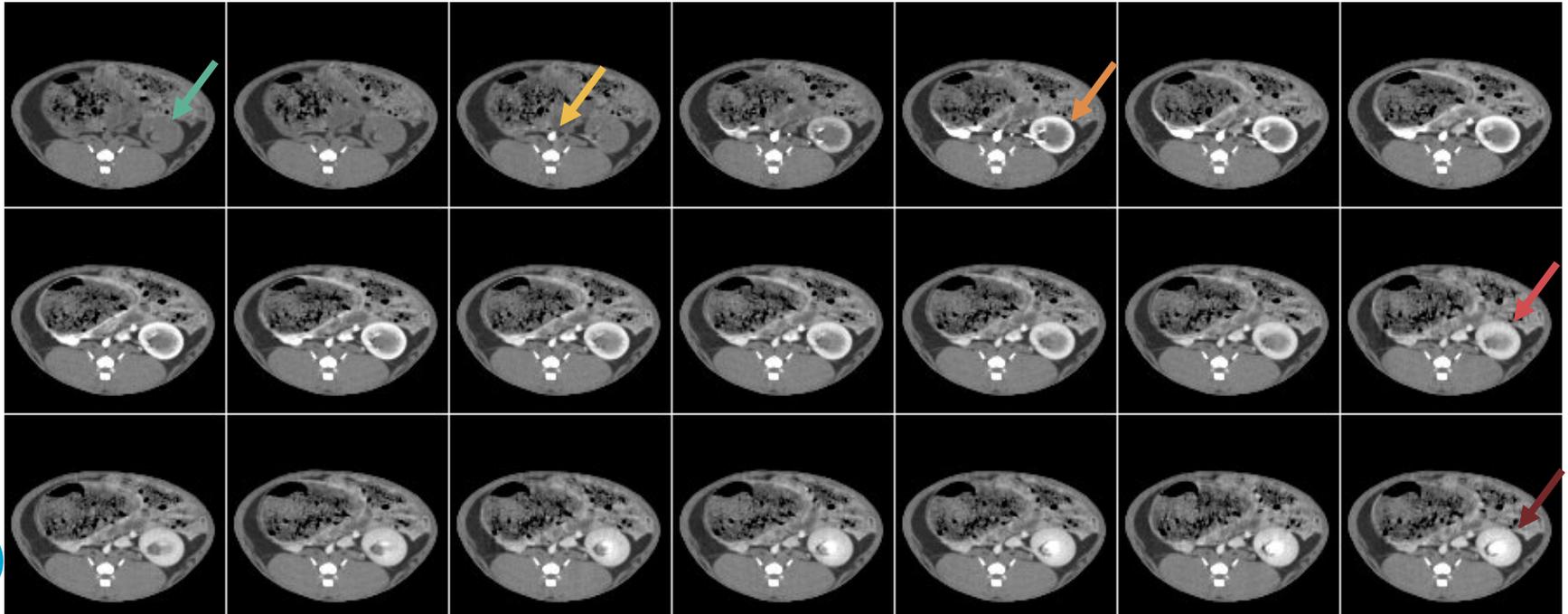
Iodine images representation of the renal perfusion
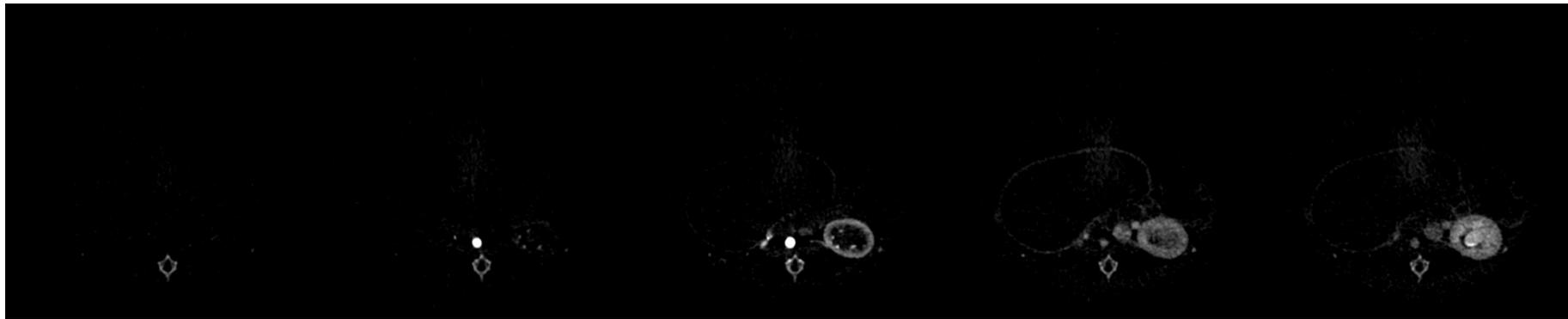
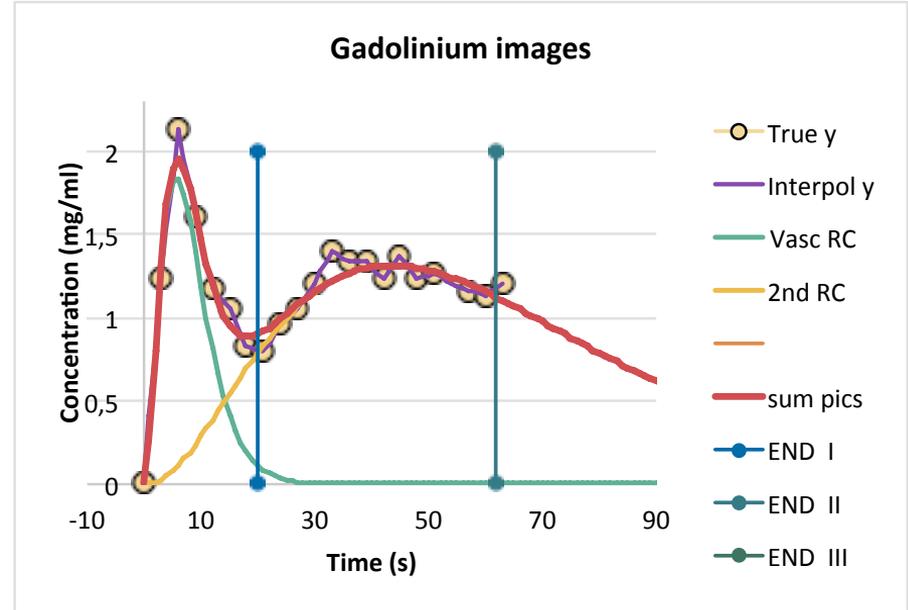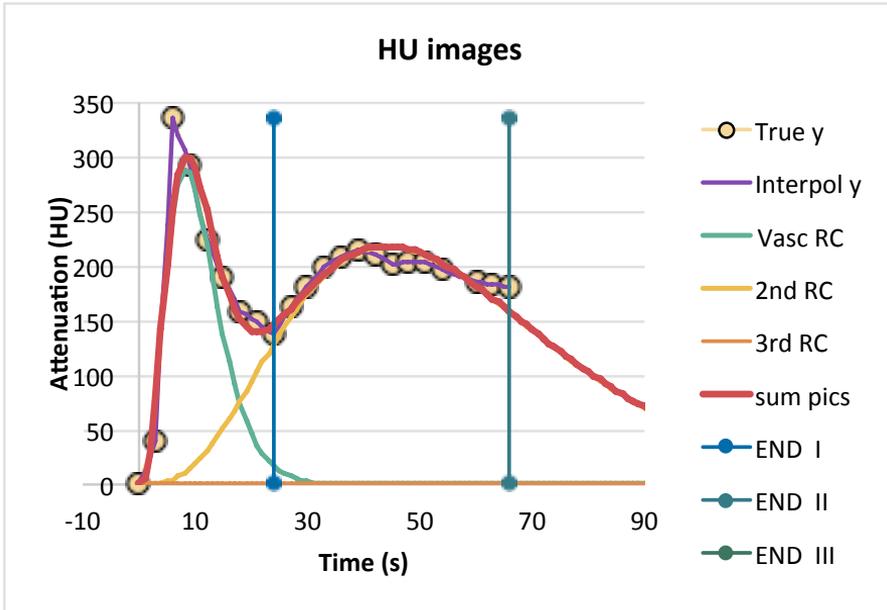# Gadolinium images representation of the renal perfusion
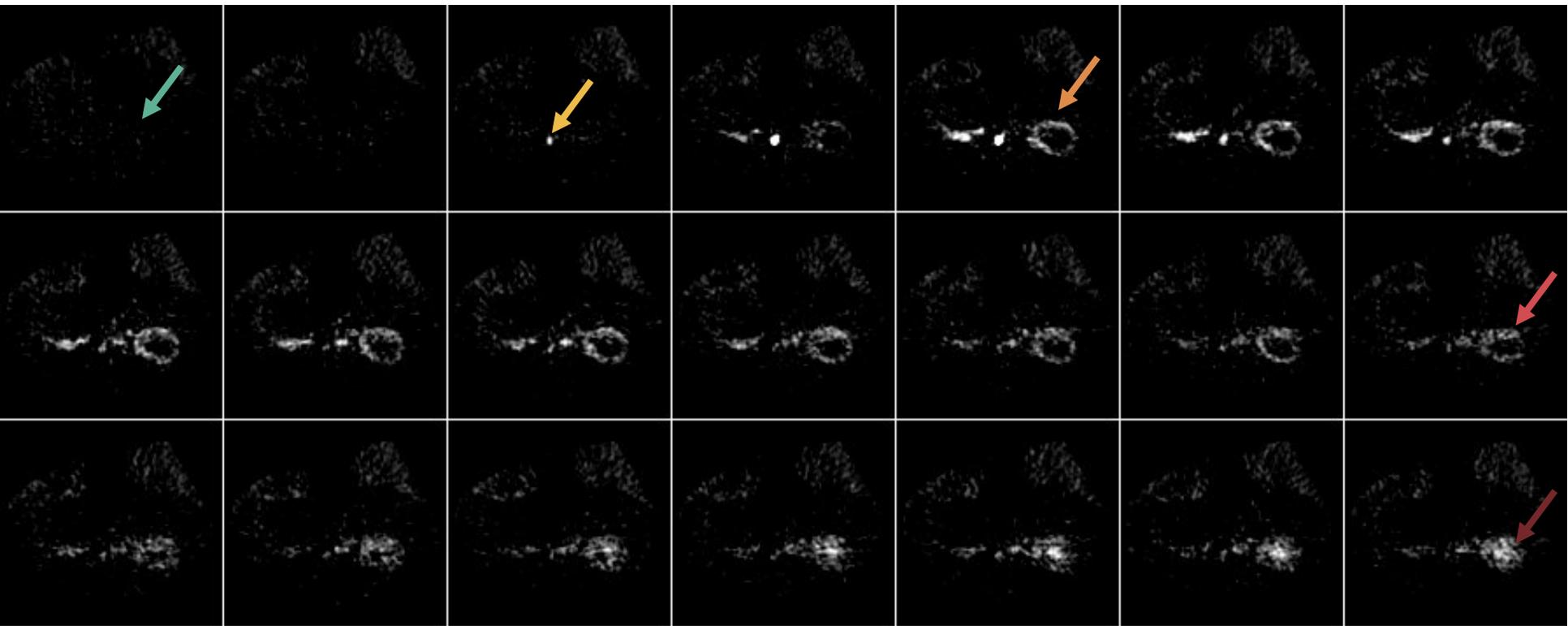
RESULTS

≡ SPCCT images allowed modelisation of kidney perfusion using a validated gamma variate model
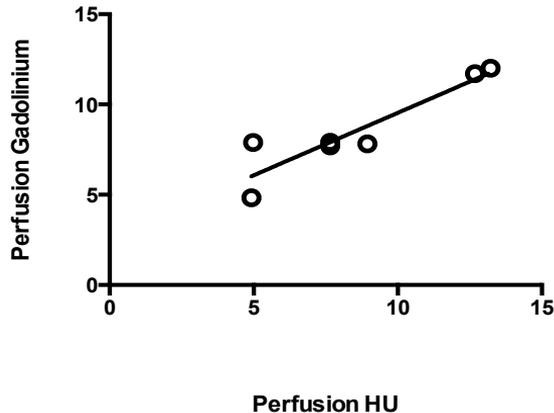
RESULTS

- Significant correlation of the renal perfusion between HU and gadolinium and iodine images
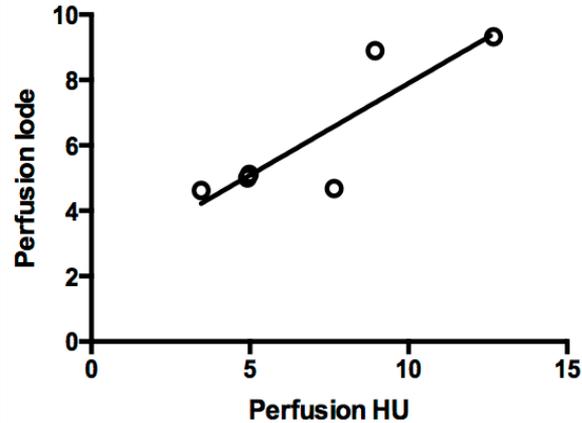

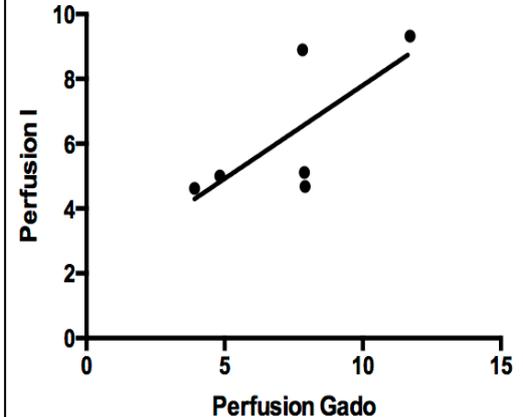Correlation between HU and Gadolinium images — r=0.91, p=0.003

Correlation between HU and iodine images — r = 0,86, p=0;02

Correlation between gadolinium and iodine images — r=0.71, p=0.1

CONCLUSION

– <u>High spatial resolution with HU, gadolinium and iodine images</u>

– <u>High spectral resolution</u>

  • Discrimination of the contrast agents

  • Accuracy of the kidney perfusion modelisation using spectral images

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CONCLUSION

– SPCCT allows high resolution in vivo dynamic dual contrast kidney perfusion imaging and quantification with gamma variate modeling using either conventional HU or Gd K-edge specific imaging.

– 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

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ACKNOWLEDGEMENTS