POTENTIAL FOR CORONARY K-EDGE IMAGING WITH SPECTRAL PHOTON-COUNTING CT

INITIAL EXPERIENCE

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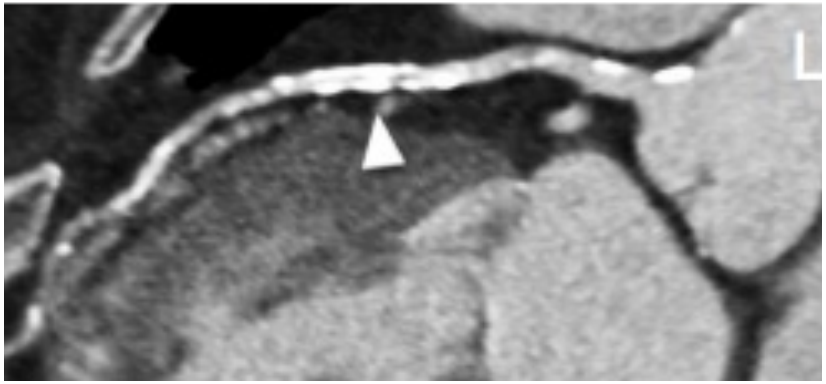
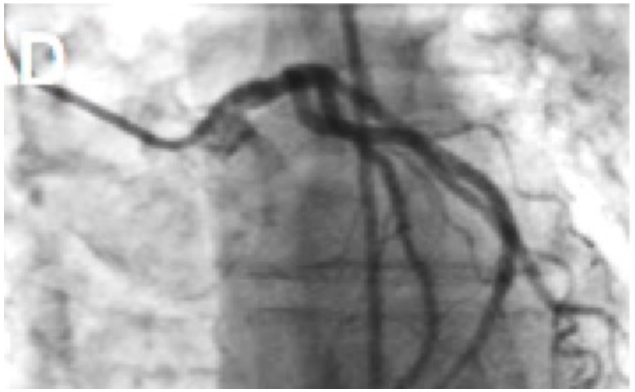
BACKGROUND

- Calcifications related **blooming artifacts** and **beam hardening** impair diagnosis of **lumen stenosis**
- Limited **spatial resolution** of standard CT[(1)]

=> Limited performance for evaluation of calcified coronary arteries [(1)]





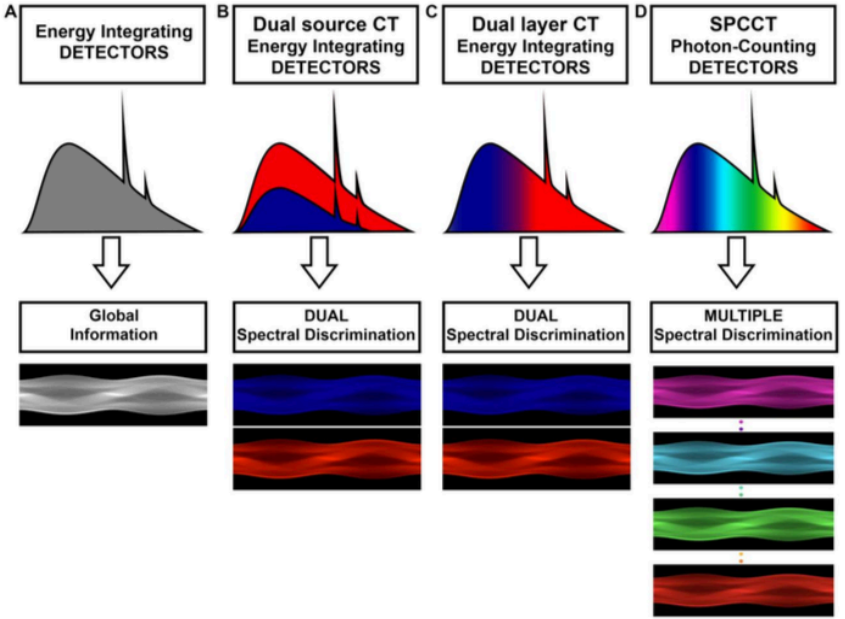
[(1)] *Rossi A et al. J Cardiovasc Comput Tomogr. 2017*

OBJECTIVE

Objectif: To assess the potential of a preclinical Spectral Photon Counting CT scanner to improve vascular imaging in the presence of calcifications using a K-edge method imaging

INTRODUCTION

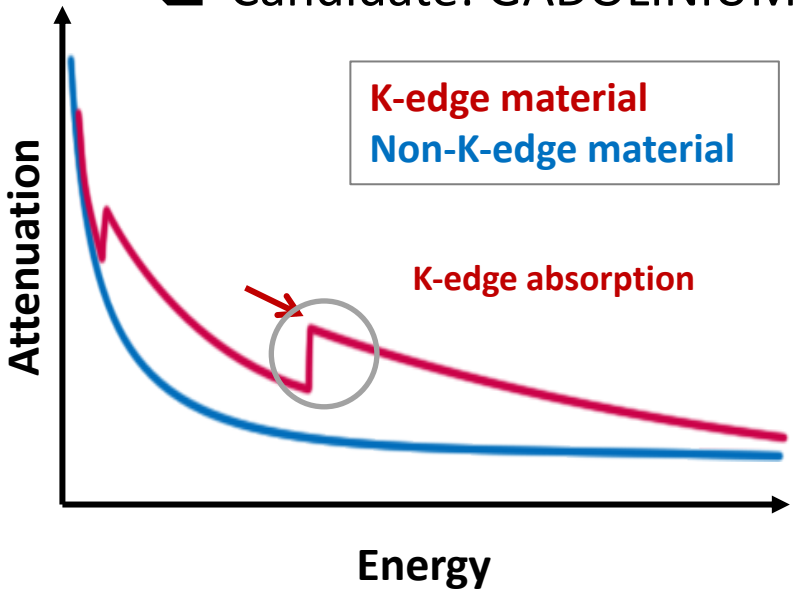
- Spectral photon-counting computed tomography (SPCCT) technology
  - New and promising imaging modality
  - Development of energy resolving detectors called photon-counting detectors [1]
    - **K-edge imaging**
  - Improved intrinsic spatial resolution [1]



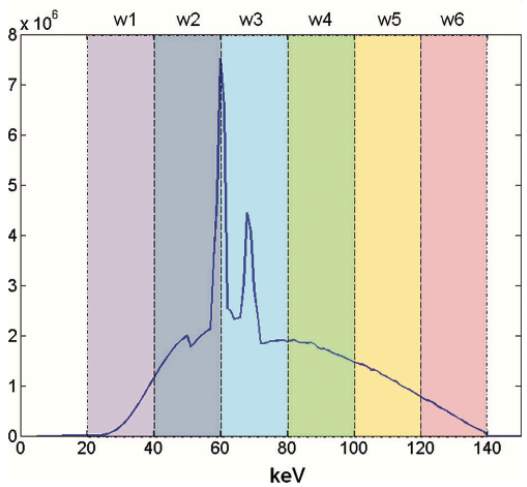
[1] *Si-mohamed et al. NIMAA. 2017*

INTRODUCTION

- "K-edge imaging"(1)
  - Candidate: GADOLINIUM



- Advantages :
  - Material specific K-edge imaging



(1) Mc Collough. Radiology. 2015

INTRODUCTION

– Feurlein *et al.* Radiology. 2008

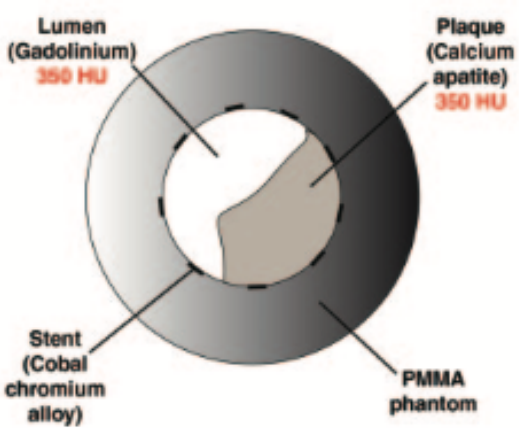
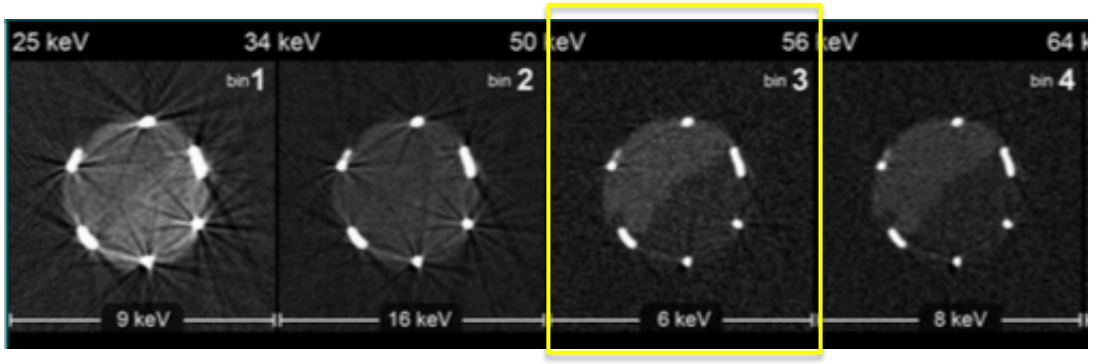


Figure 3: Illustration of polymethylmethacrylate (*PMMA*) phantom with simulated plaque in stent.



MATERIAL/METHODS

- Spectral photon-counting CT system
  - 5 bins photon-counting detectors set as 30, 51, 64, 72, 85 keV
  - Modified clinical base-Conventional X ray tube
  - Field of vue of 160 mm-Gantry rotation time of 1 second
  - **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 AND METHODS

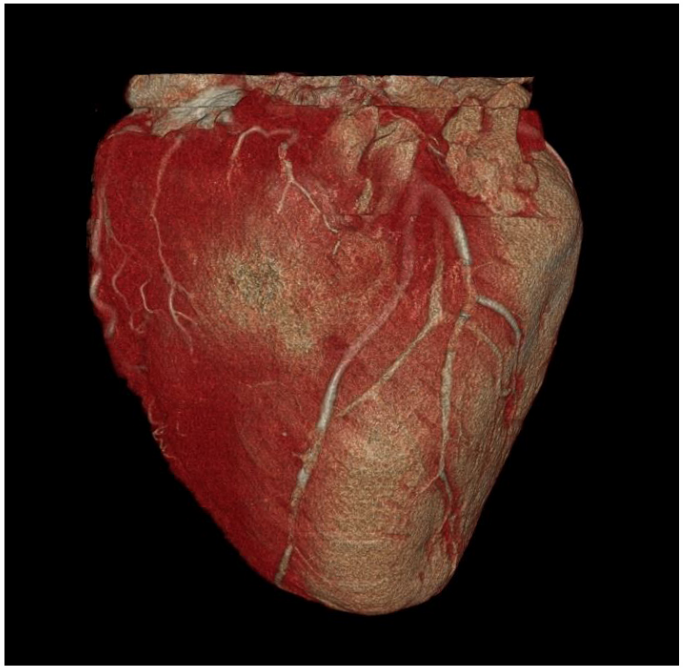
- **EX VIVO HUMAN HEARTS**
  - Remodeling with wax in the cavities
  - Proximan catheter of coronaries
- **Contrast agents**
  - **macrocyclic gadolinium based contrast agent** (Prohance, Bracco)
  - Concentration targeted for 400 UH
    - 1/7 dilution

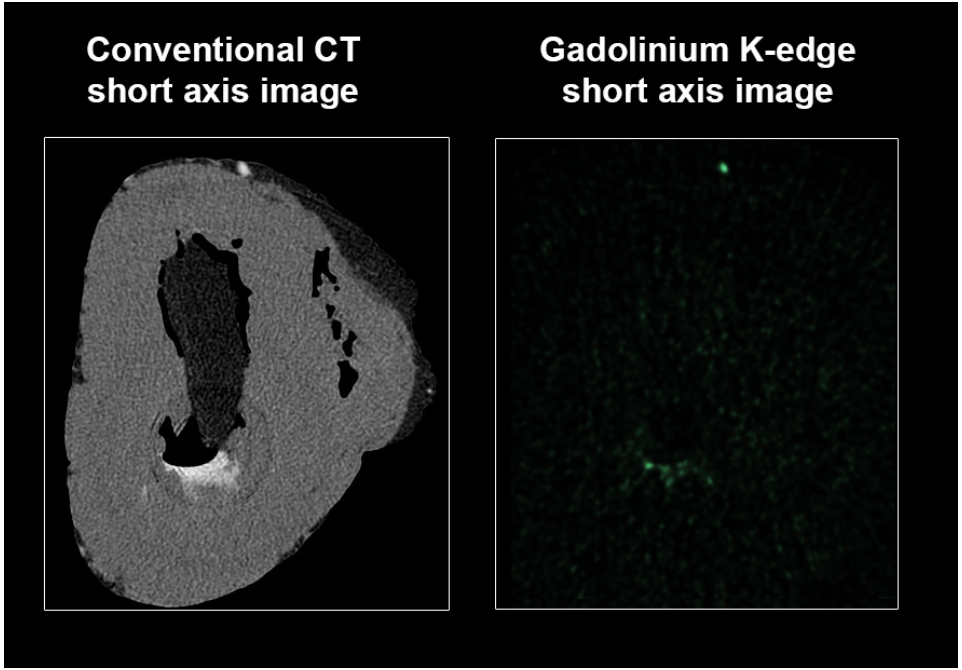
- **SPCCT reconstructions**
  - Conventional HU map and Gadolinium K-edge map
  - Filter Gaussian 2 pixels on gadolinium map

- **Image analysis**
  - 30 points read by two observers on a curvilinear reconstruction of the vessel on the conventional and gadolinium maps

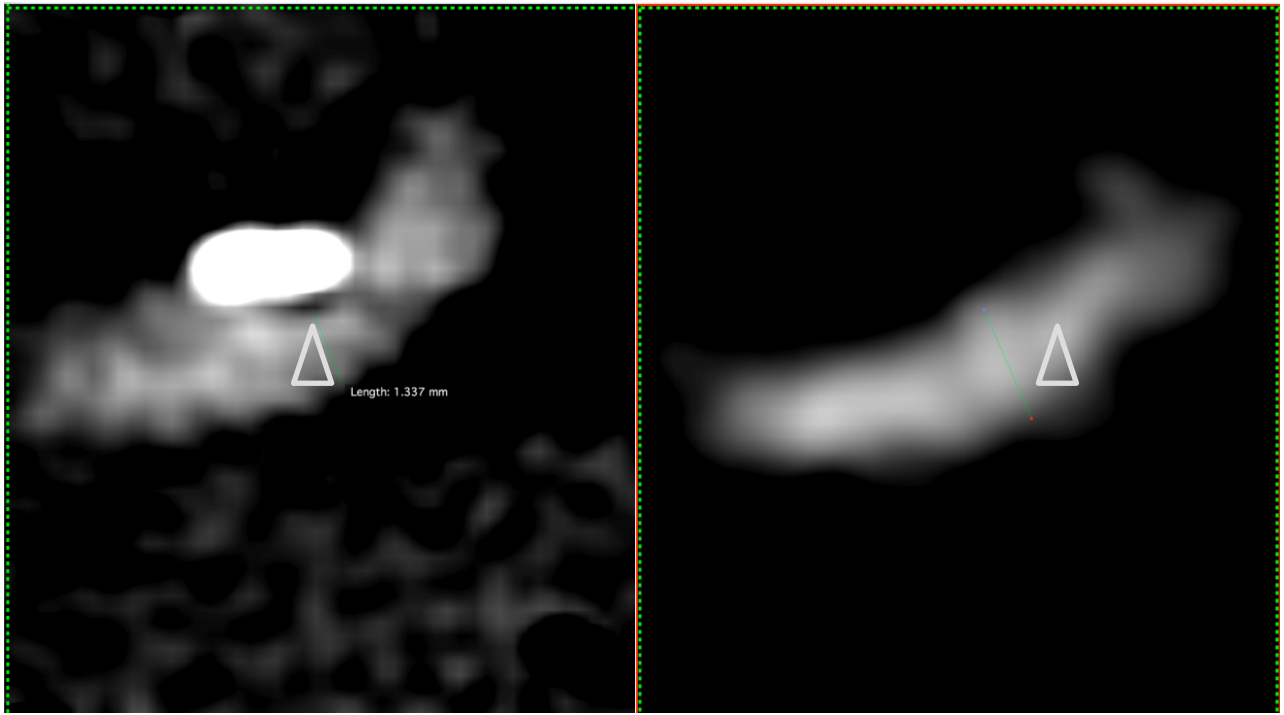
- **Statistical analysis**
  - Comparison of the measures by a paired t-test
  - Inter and intra-observers concordance evaluated by a Kappa-test

RESULTS




Conventional CT
short axis image
Gadolinium K-edge
short axis image

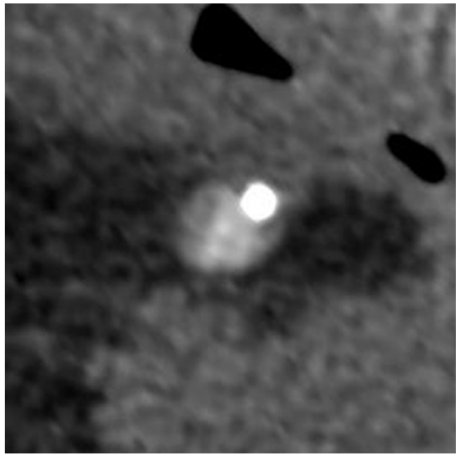
RESULTS

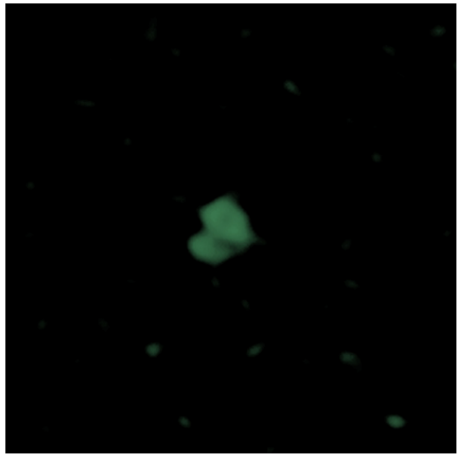


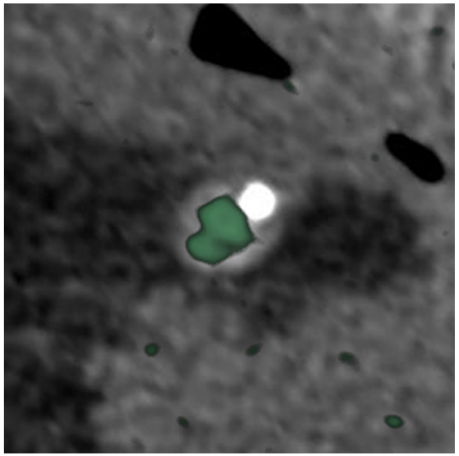
SPCCT
IMAGING ALL THE PHOTONS

RESULTS

Conventional CT image	Gadolinium K-edge image	Overlay image







SPCCT
IMAGING ALL THE PHOTONS

RESULTS

Sections of coronary arteries	HU	K-edge
	Measured diameter (cm)	
Calcified area	2.0±0.1 cm	2.2 ± 0.1 cm*
Non calcified area	4.2 ± 0.6	4.2 ± 0.6 ns

* - $p < 0.05$

Sections of coronary arteries	HU	K-edge
	Coefficient Kappa	
Concordance intra-obs	0.92	0.85
Concordance inter-obs	0.85	0.75

Test Kappa: nul (k = 0.00–0.20), faible (k = 0.00–0.20), moderate (k = 0.41–0.60), good (k = 0.61–0.80), or excellent (k = 0.81–1.00)

DISCUSSION

- Specific visualization of the gadolinium in the coronary arteries lumen
- Lumen diameter significantly higher with K-edge imaging than with conventional images in case of calcified coronary arteries

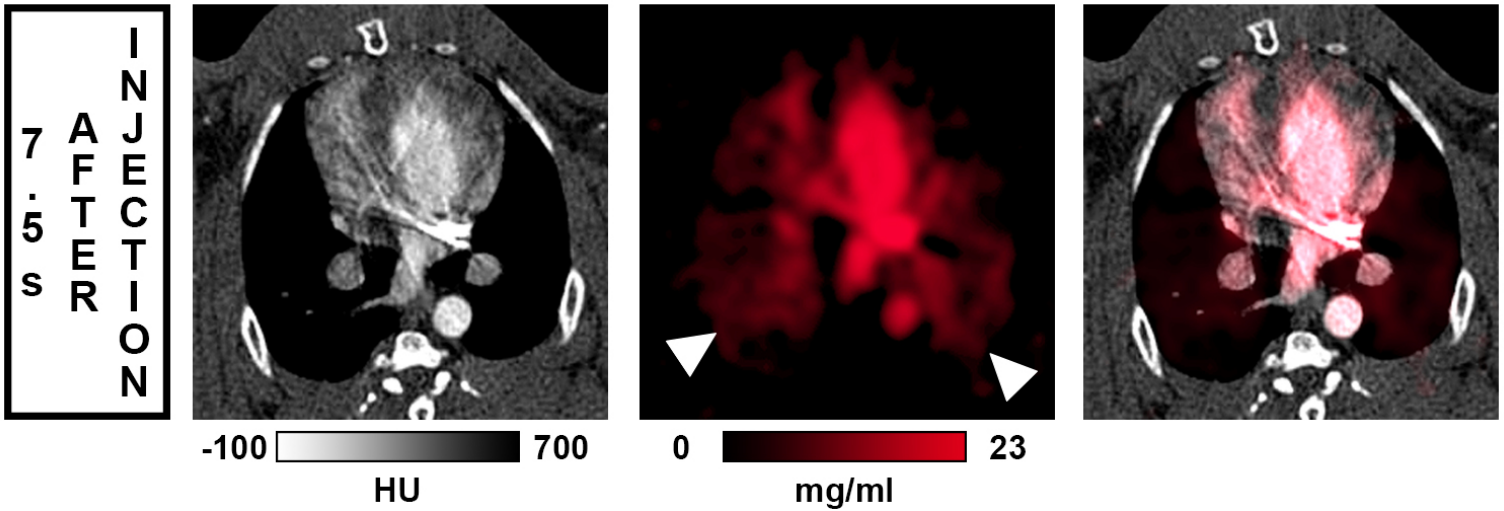
$\Rightarrow$ **Better depiction of lumen diameter quantification**

LIMITS

- No evaluation of the grant truth lumen diameter
- High concentration of gadolinium needed

CONCLUSION

- Potential of gadolinium K-edge coronary imaging
- Novel contrast agent gadolinium based



THANK YOU FOR YOUR ATTENTION

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