

Contribution of dual energy in oncology follow up

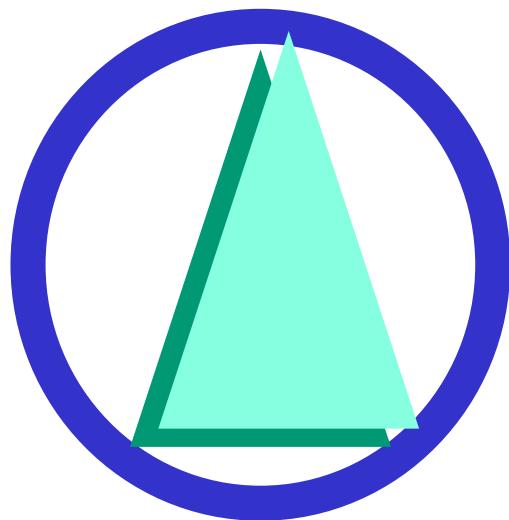
Siemens workshop 6 march 2020

Dr Ouertani MS Delta Hospital CHIREC

Mettat Abdelaziz, Hancart Sharon and Vincent Besonhé -
Siemens Healthcare

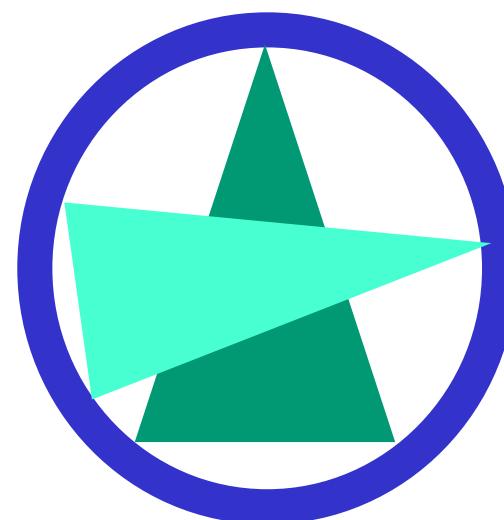
Dual energy spectral separation

Monotube
Twin Beam



Somatom Go.TOP

Dual Tube
1 passage



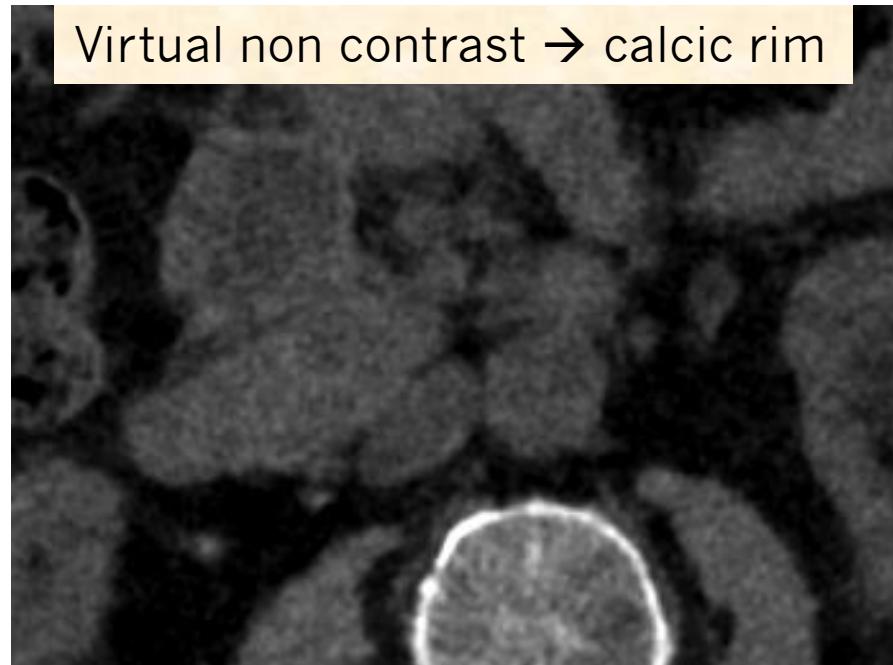
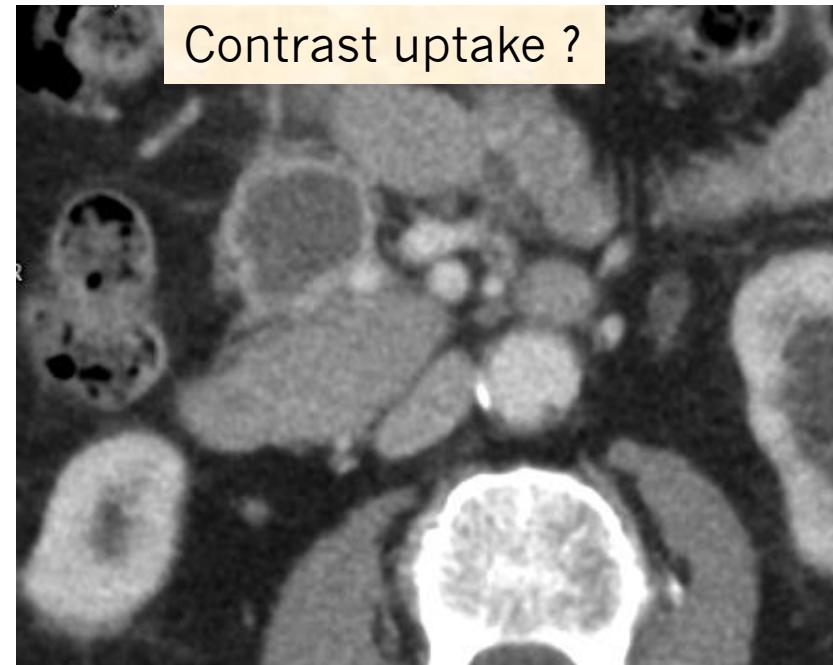
Somatom FORCE

Dual energy CT and oncology

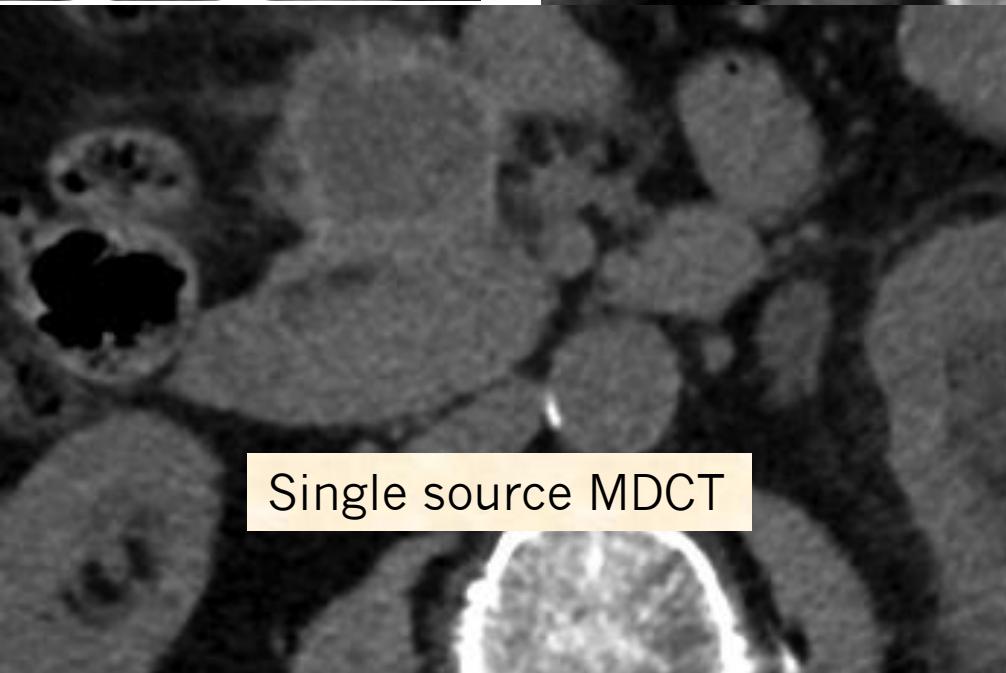
- Virtual non contrast : dose sparing
- Mono-energetic imaging :
 - detection
 - contrast sparing
- enhancement studies :
 - Characterization
 - Follow up under treatment
- Virtual non calcium imaging : multiple myeloma

Contrast uptake ?

Virtual non contrast → calcic rim



VNC versus TNC



www.chirec.be

Total mAs 2160 Total DLP 230 mGycm

Dual source MDCT with contrast

	Scan	kV	mAs / ref	CTDlvol*	DLP	TI	cSL
				mGy	mGycm	s	mm
Patient Position F-SP							
Topogram	1	120	19 mA	0.07 L	3.6	5.3	0.6
DE_Abd Veineu	2A	90	92 / 152	4.73 L	226.7	0.5	0.6
	2B	Sn150	60 / 95				

mAs total 3662 DLP total 296 mGycm

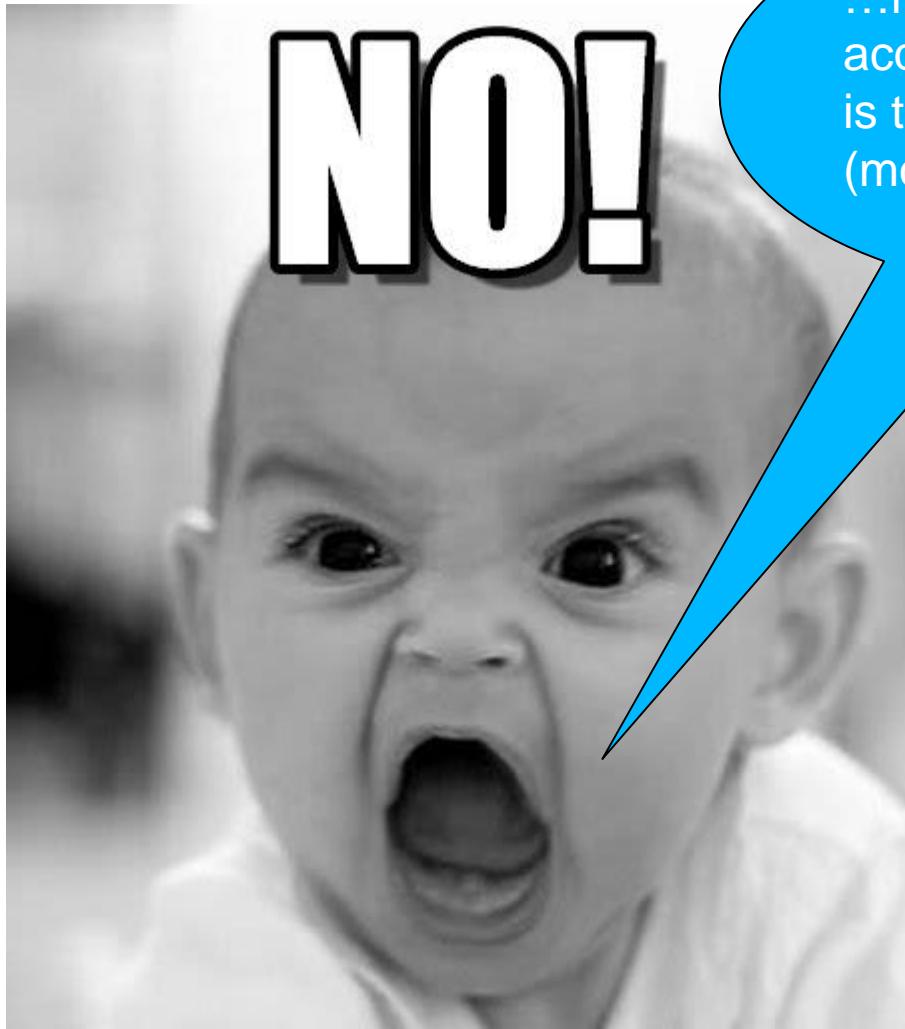
Single source MDCT

	Scan	kV	mAs / réf.	CTDlvol*	DLP	TI	cSL
				mGy	mGycm	s	mm
Position du patient H-SP							
Topogramme	1	120	35 mA	0.13 L	5	4.2	0.6
Abdo A Blanc	2	100	136 / 268	6.10 L	291	0.5	0.6

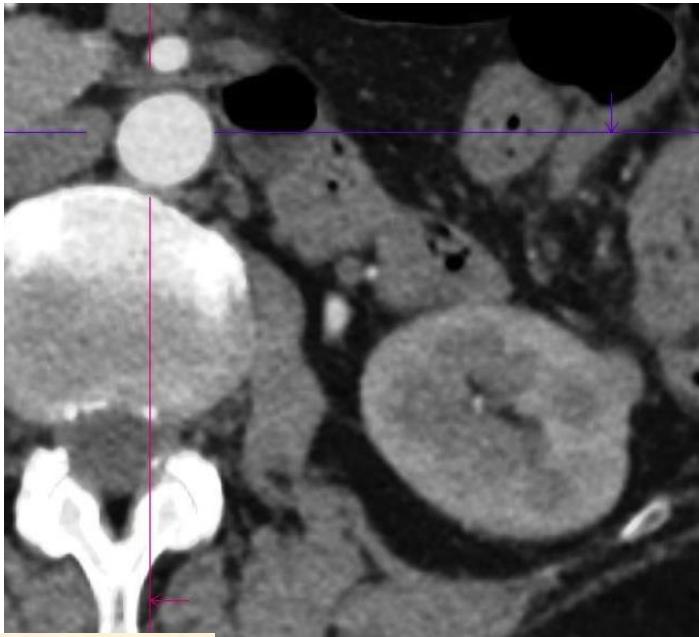
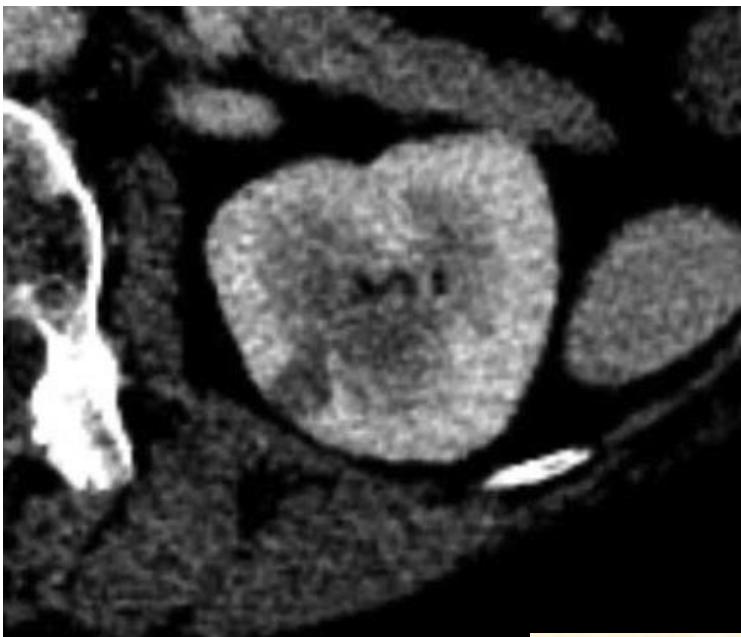
DRL simple examination : P25 = 320 mGy.cm

DRL complete examination : P25 = 350 mGy.cm

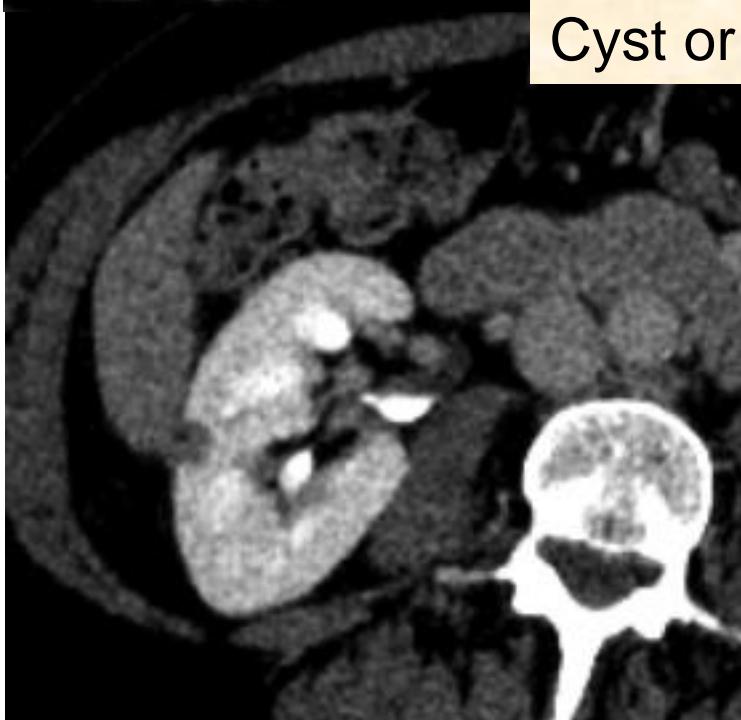
VNC versus TNC

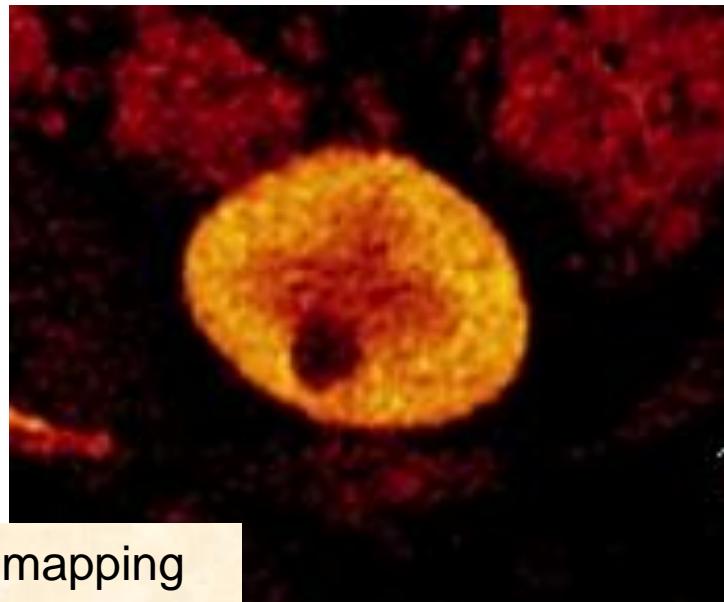
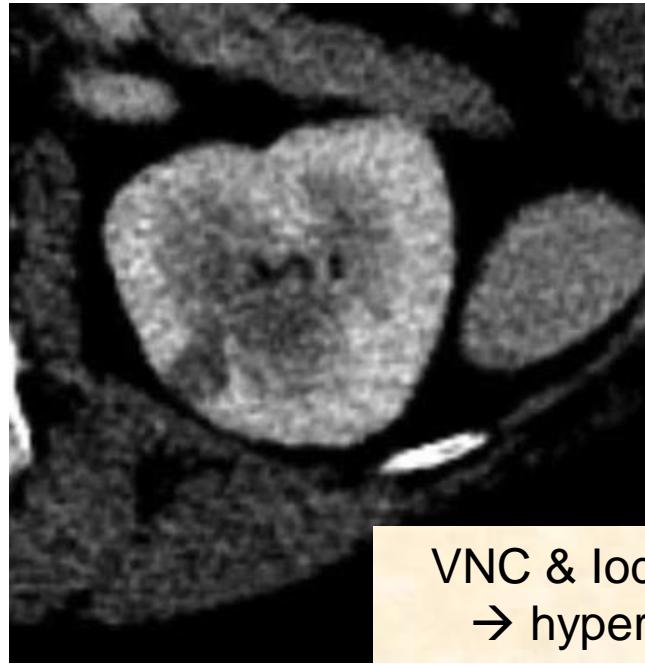


...non contrast
acquisition if contrast
is to be injected
(most often)

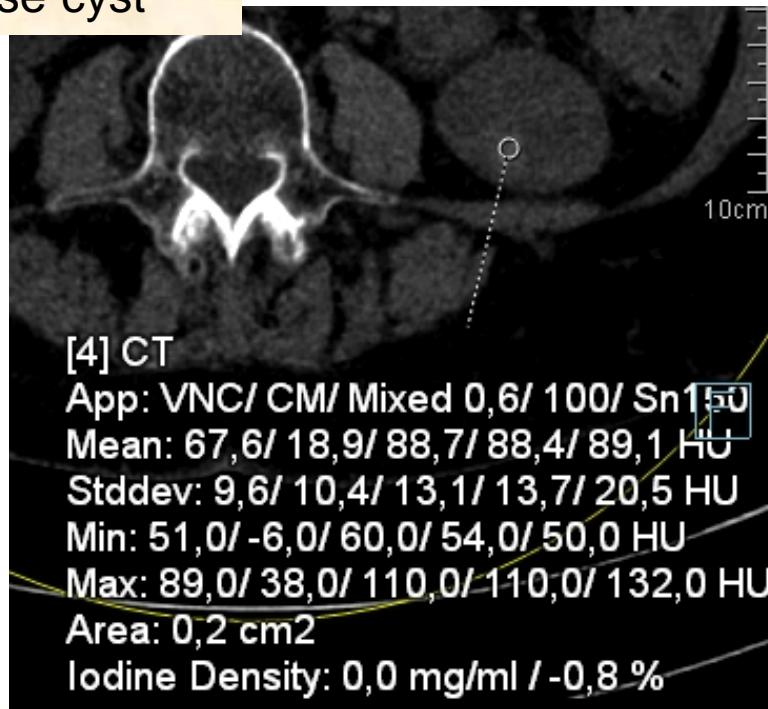
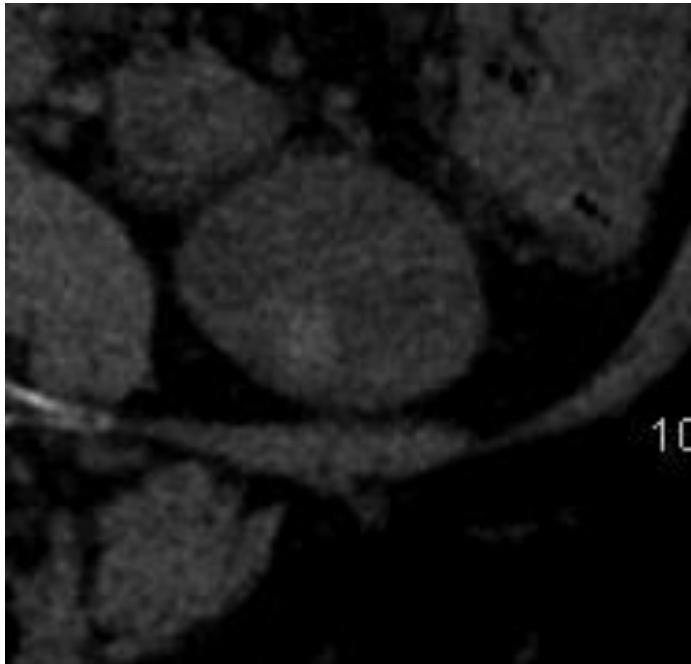


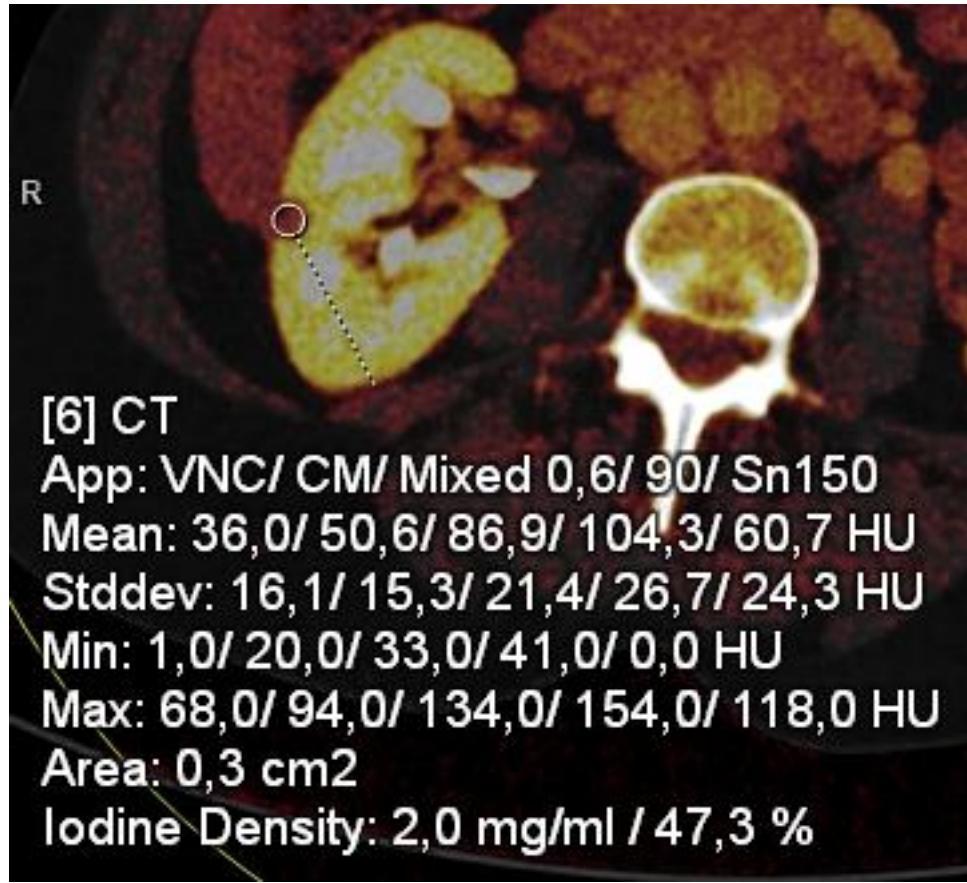
Cyst or tumour ?



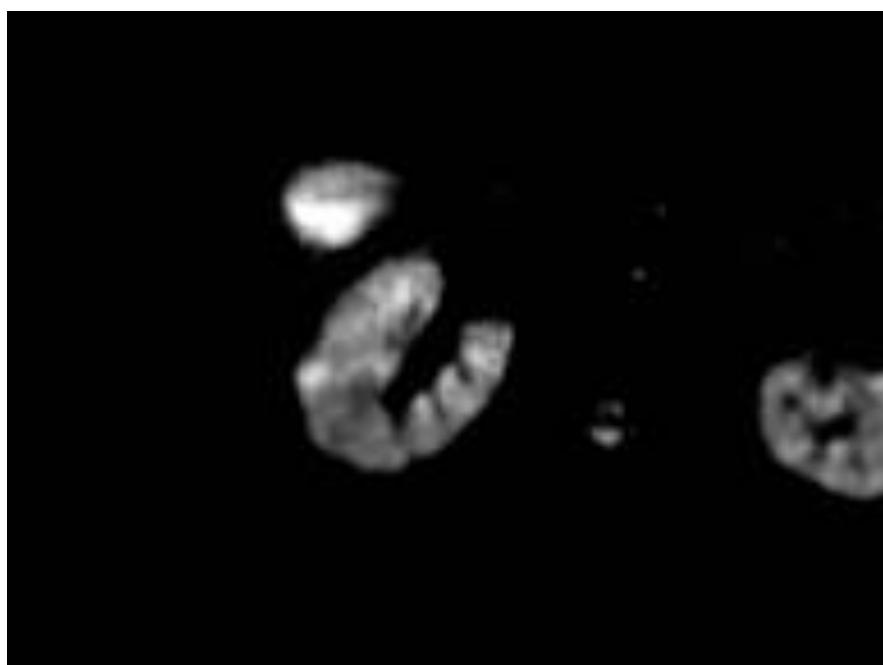
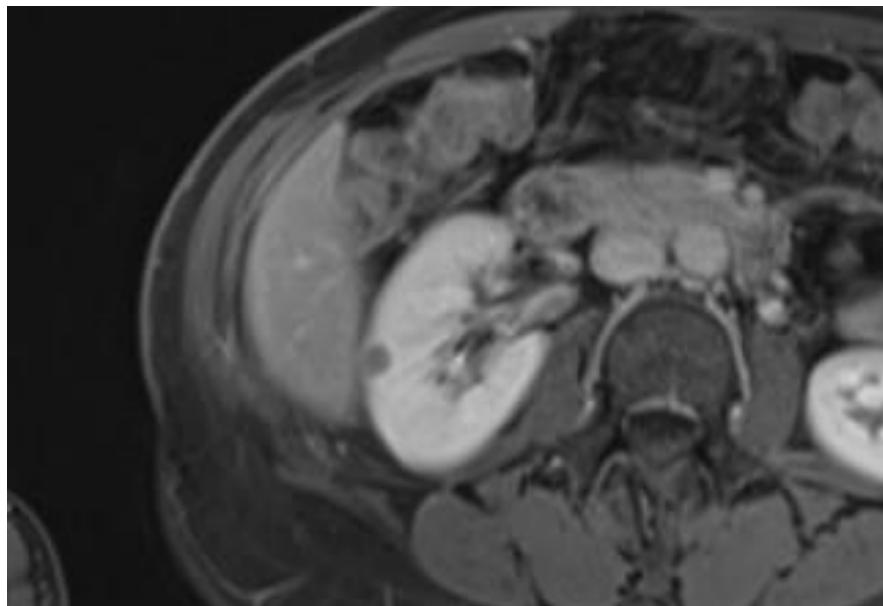
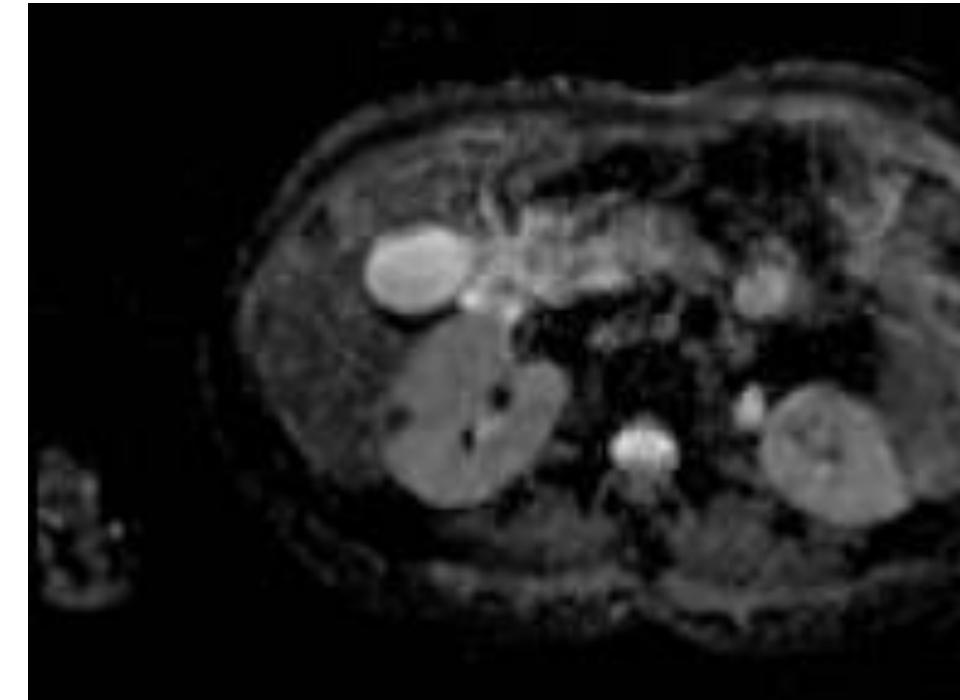


VNC & Iodine mapping
→ hyperdense cyst

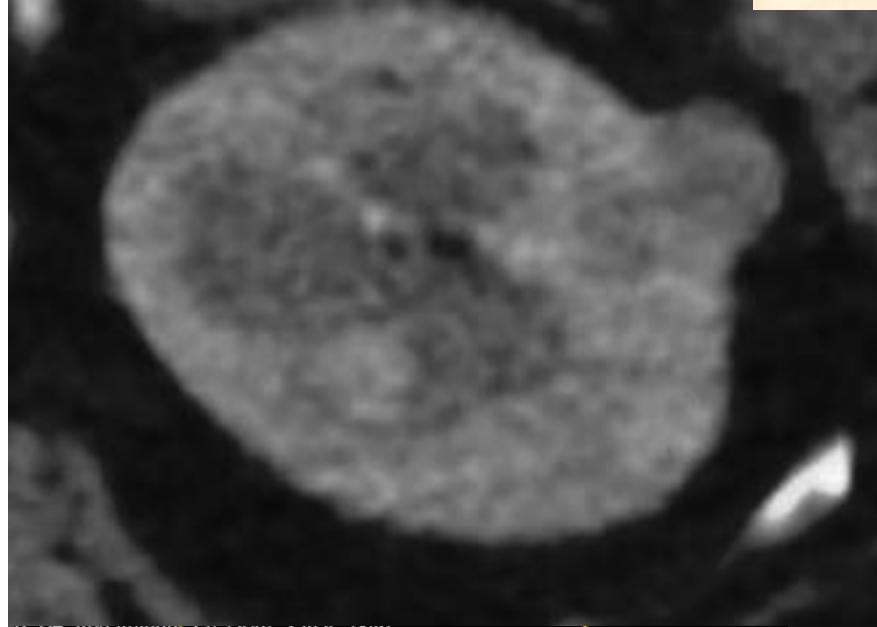




Contrast uptake
→ small papillary tumour



Cysts !



P DE Adu Venmed 1.0 QI40 Z VOL [0/5]

[3] CT

App: VNC/ CM/ Mixed 0,6/ 100/ Sn150
Mean: 34,8/ 8,5/ 63,7/ 64,0/ 63,4 HU
Stddev: 8,8/ 11,3/ 8,0/ 11,1/ 15,2 HU
Min: 38,0/ -15,0/ 45,0/ 36,0/ 32,0 HU
Max: 73,0/ 28,0/ 84,0/ 83,0/ 91,0 HU
Area: 0,3 cm²
Iodine Density: 0,0 mg/ml / 0,7 %



[3] CT

App: VNC/ CM/ Mixed 0,6/ 100/ Sn150
Mean: 46,1/ -4,5/ 41,6/ 39,5/ 44,7 HU
Stddev: 10,3/ 13,4/ 9,9/ 15,2/ 17,6 HU
Min: 18,0/ -31,0/ 16,0/ 12,0/ 0,0 HU
Max: 70,0/ 23,0/ 70,0/ 74,0/ 83,0 HU
Area: 0,6 cm²
Iodine Density: -0,3 mg/ml / -6,0 %

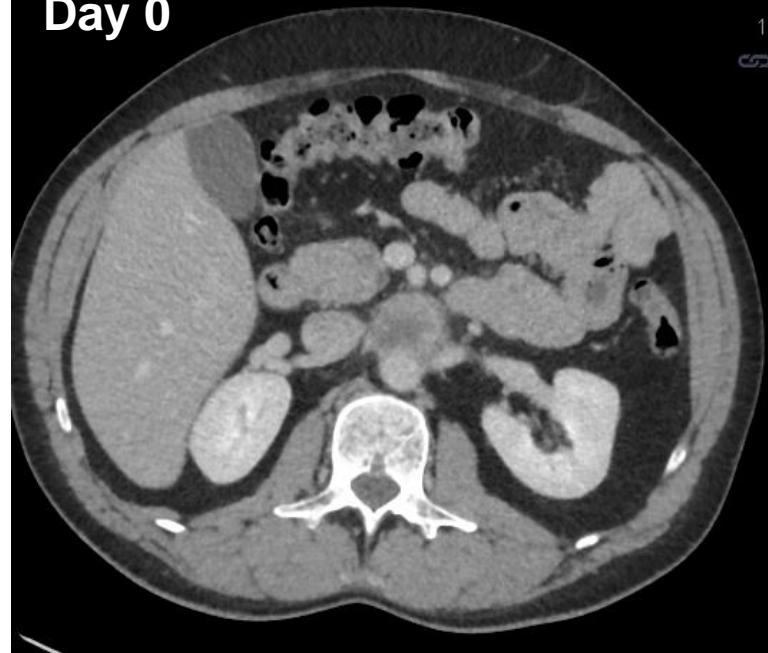
Let's move to some cases !!



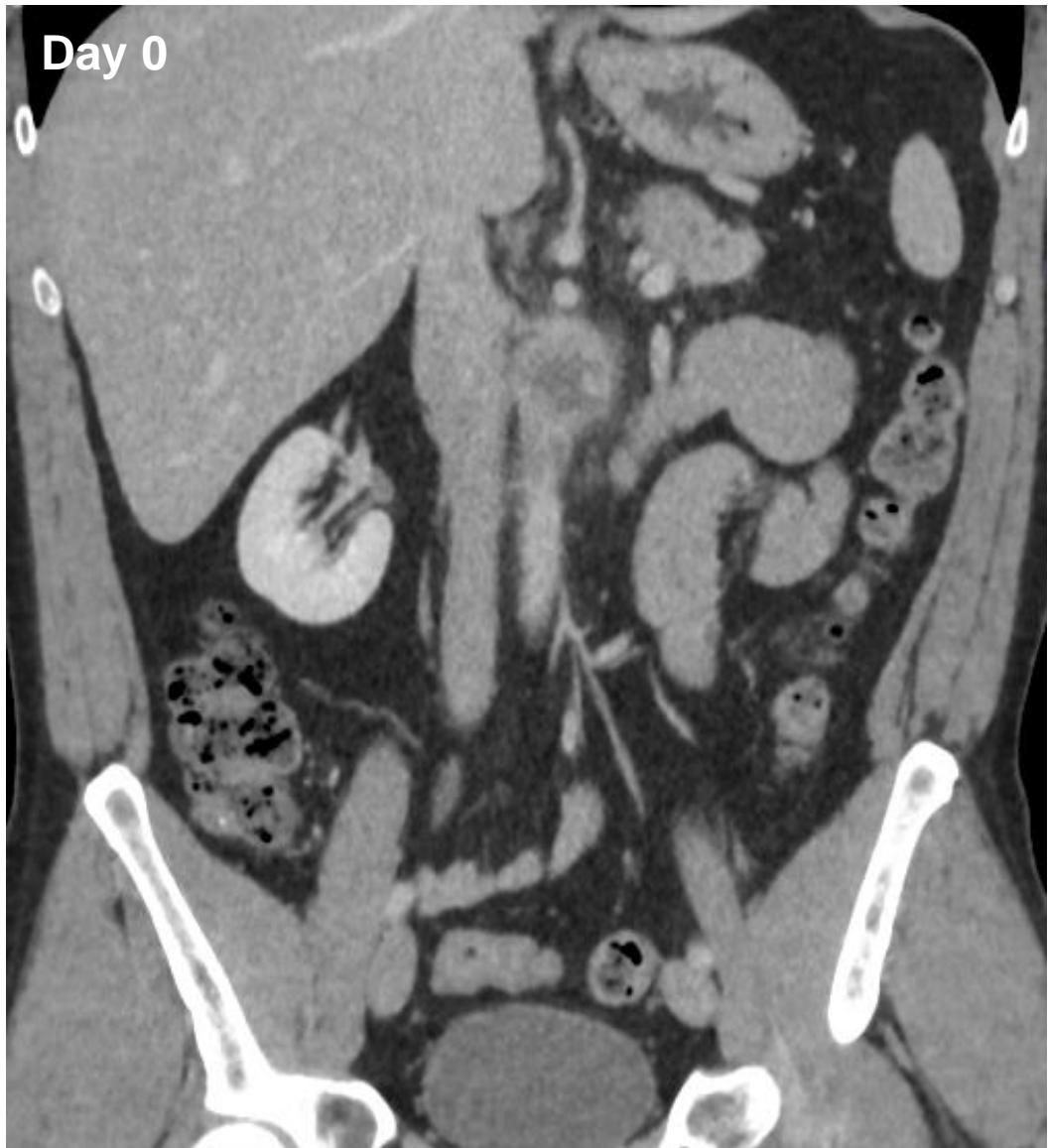
Case 1

- Man, 46 Y
- Abdominal pain
- Pancreatitis

Day 0



Day 0

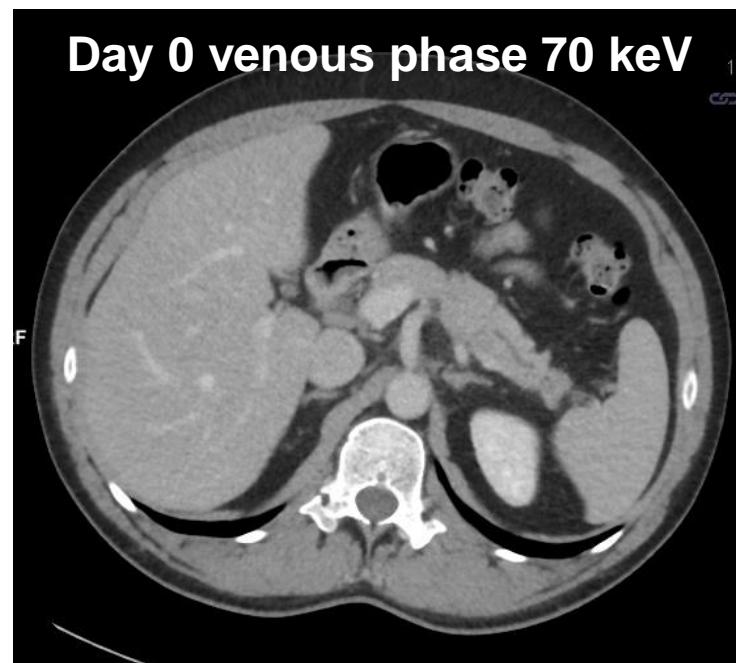


DECT venous phase

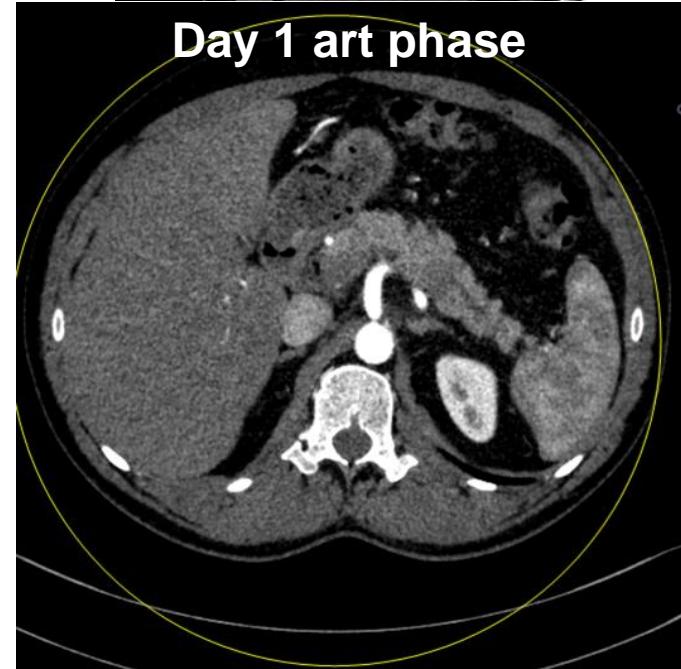
Day 1 art phase



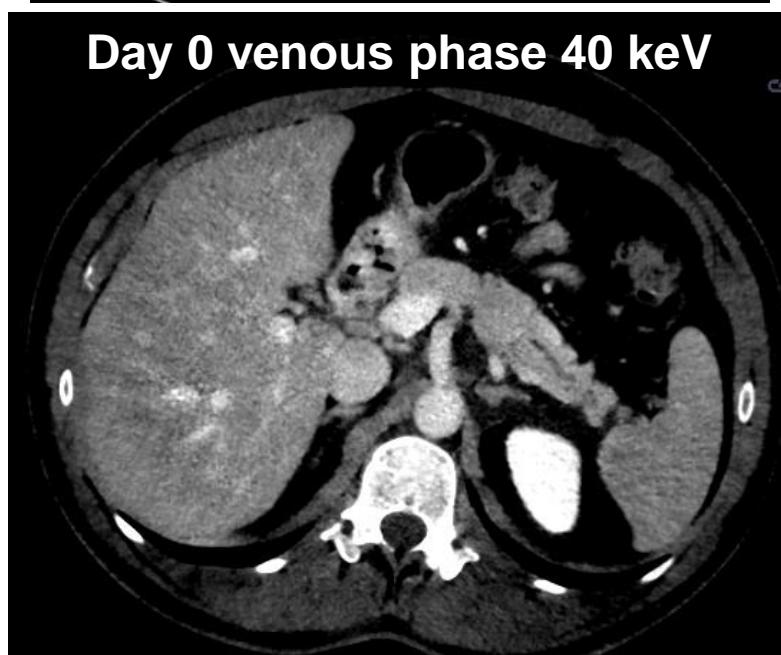
Day 0 venous phase 70 keV

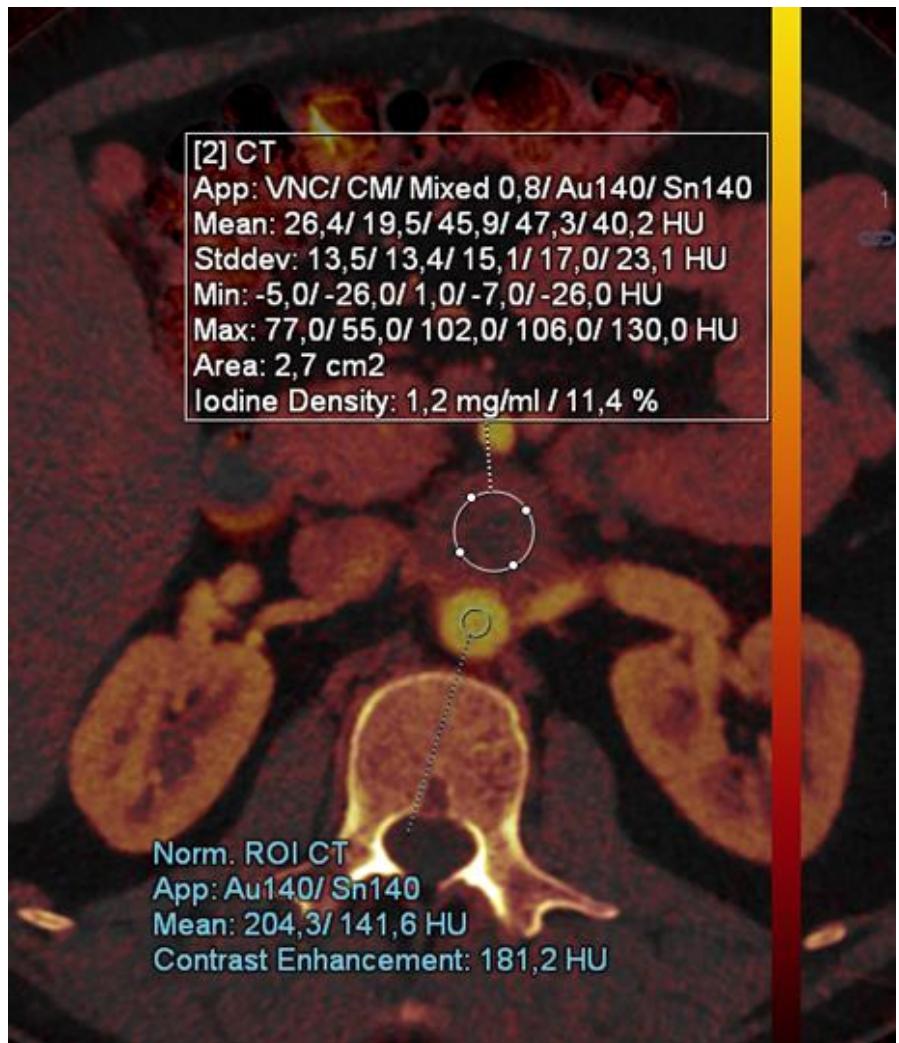


Day 1 art phase

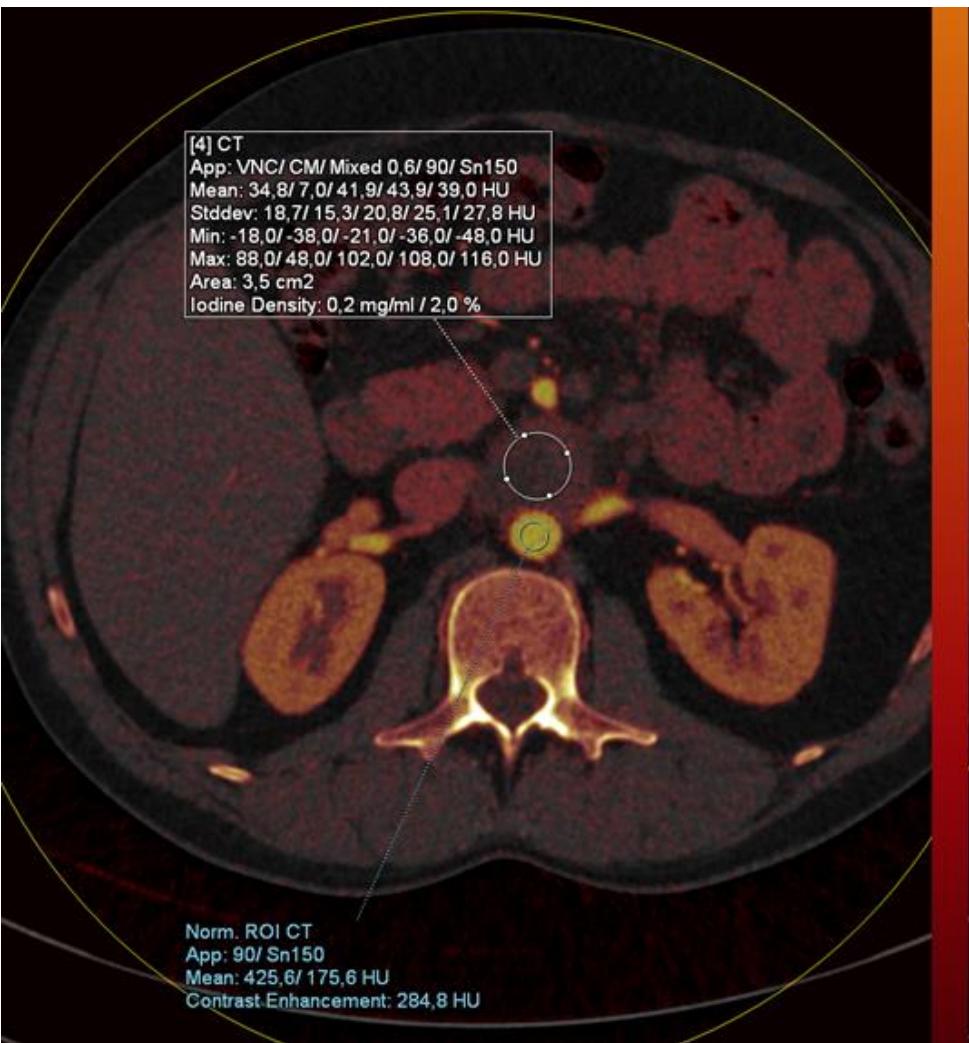


Day 0 venous phase 40 keV





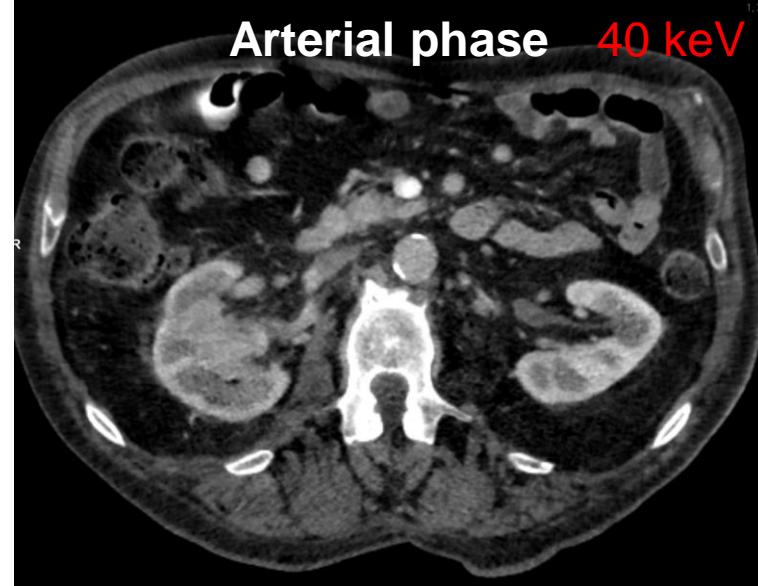
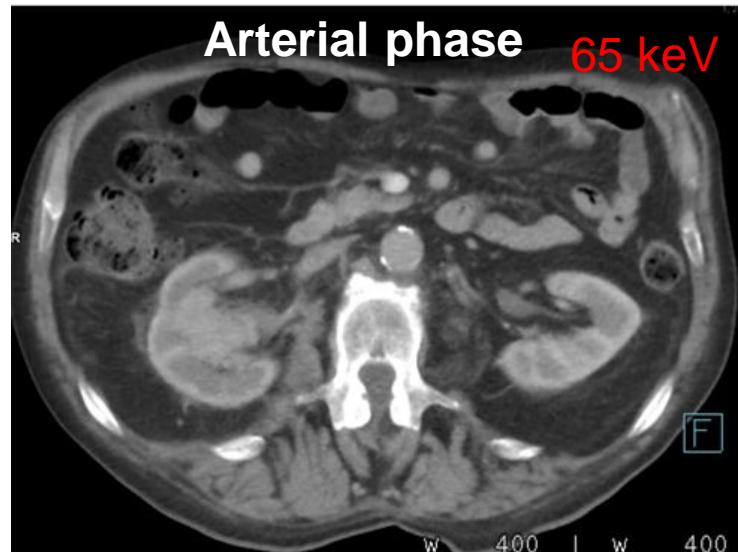
Day 1, before treatment

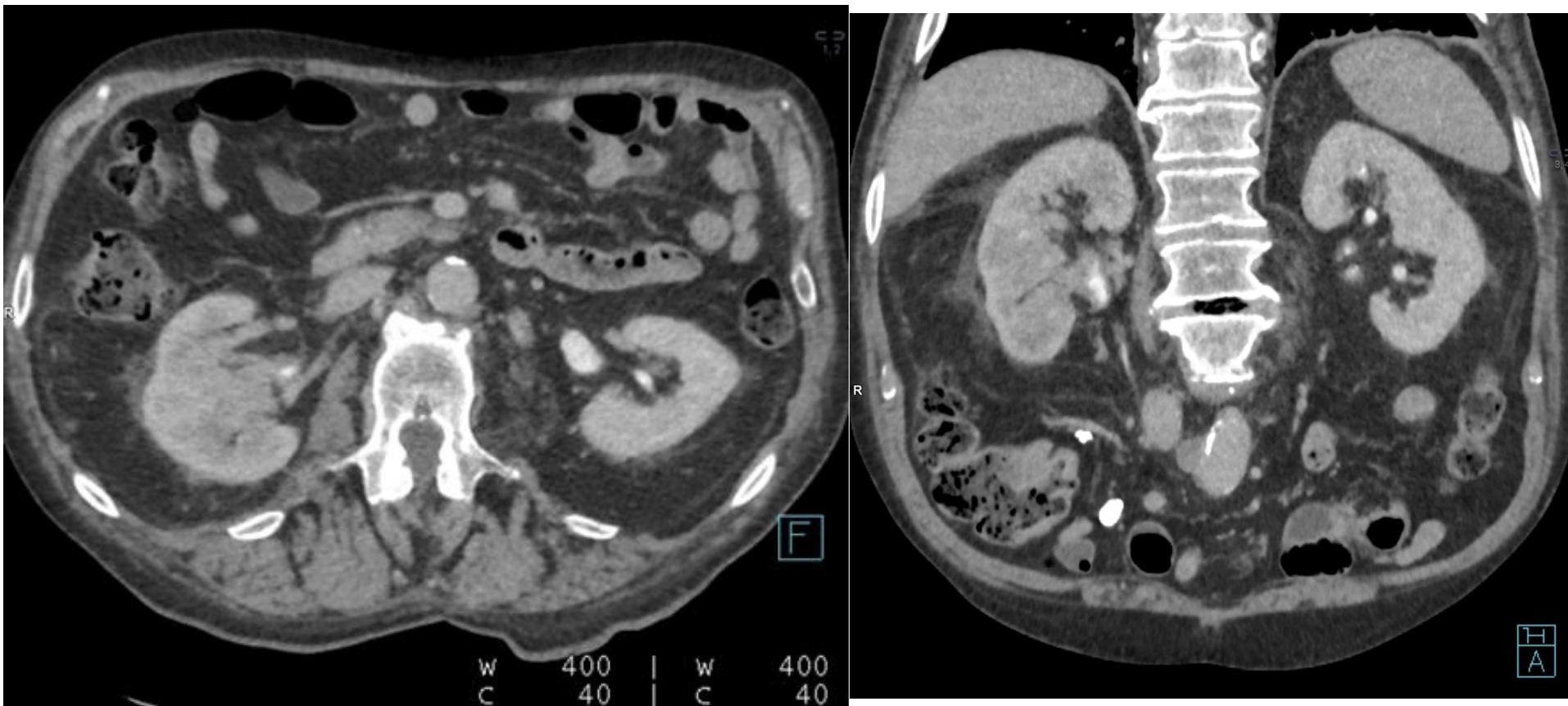


Day +15, after onset treatment

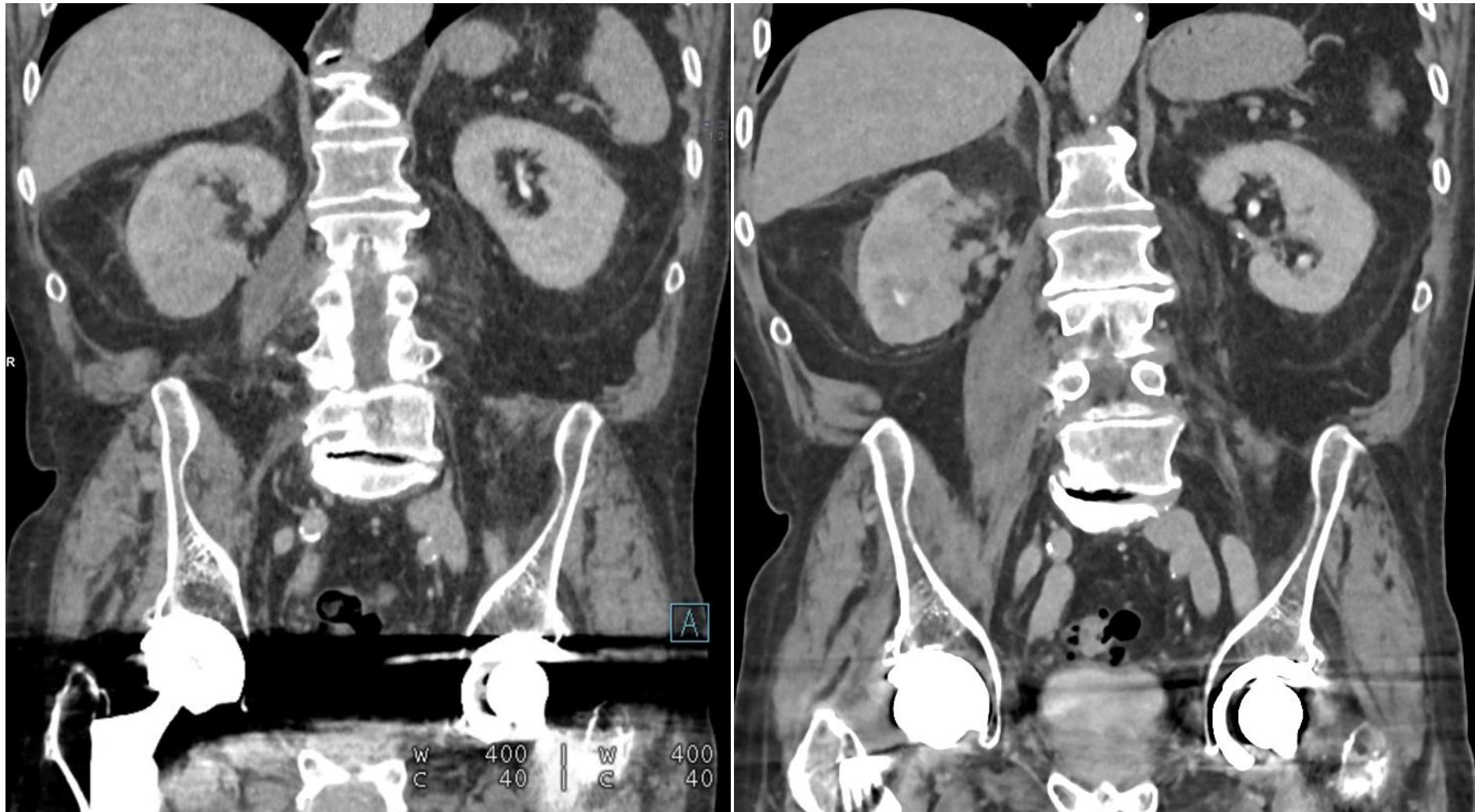
Case 2

- Man, 86 y
- Painful macroscopic hematuria
- Prostatic adenomectomy in 2017





Uro-Nephrographic phase



Optimization of metal suppression Dual energy + IMAR

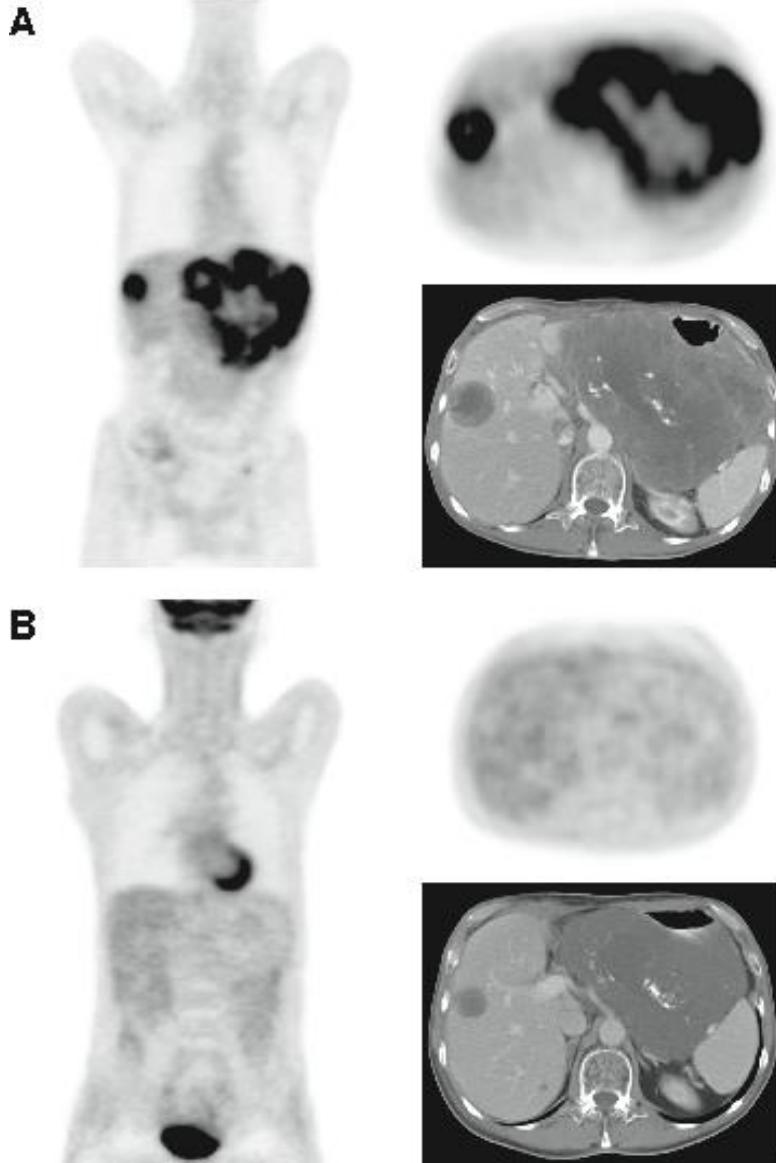
Search or follow-up of an urothelial tumor : dual energy protocol

- 1 dose of Lasix (20mg/2ml IV)
- IV Contrast medium = 350 mg I2/100 ml :
 - 60 cc (Force) / 70 cc (Go-Top)
 - Abdomino-pelvic acquisition Start Delay 35 sec >>> VNC
 - 6 minutes
 - 80 cc (Force) / 70 cc (Go-Top)
 - Abdomino-pelvic acquisition : uro-nephrographic phase
- IV Contrast medium = 400 mg I2/100 ml :
 - 60 cc / 80 cc (Force, Go-Top)

GIST

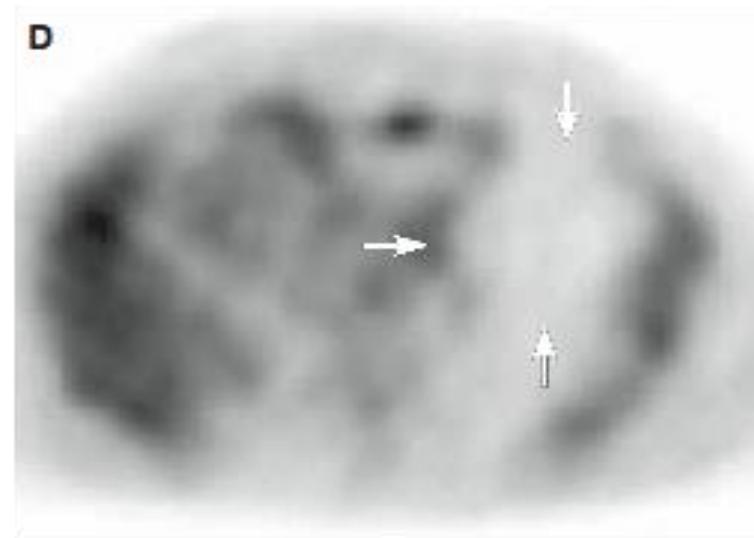
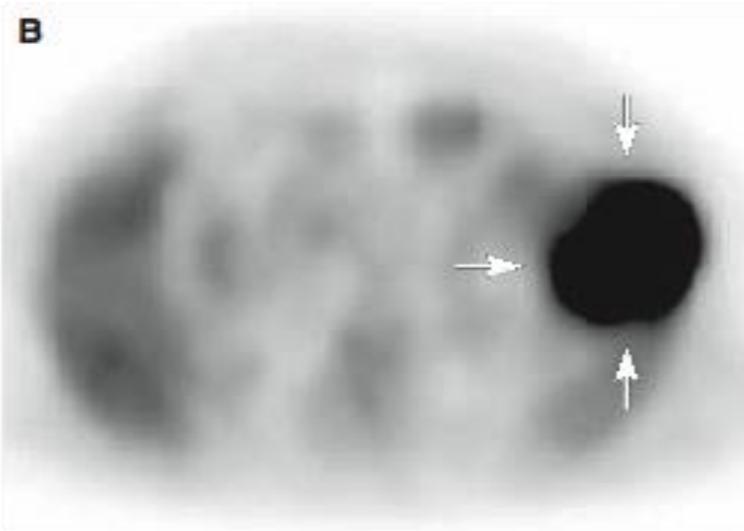
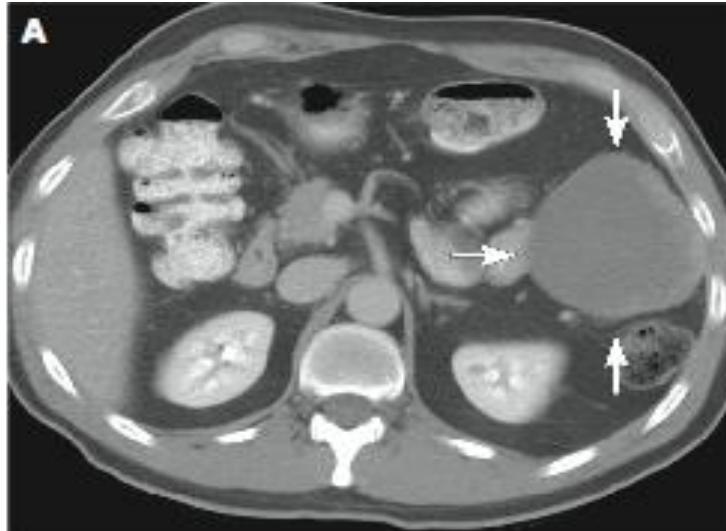
- PET-CT = gold standard (! Up to 21 % without significant metabolic activity)
 >>> baseline (CT + C+)
- CT (thoraco-abdominal) = major tool for the follow-up
- But ...

RECIST criteria alone (number and size of lesions) are not relevant enough



- Slight variation of the lesions size at short (1month) or mid term
- Appearance of pseudo new lesions

Van Den Abeele , The Oncologist 2008; 13(suppl 2): 8-13



Haesun Choi ; J Clin Oncol 25 : 1753 - 1759

Myxoïd degeneration / haemorrhage (2 m of treatment)

www.chirec.be



Table 2 Summary of the RECIST 1.1 and Choi criteria for treatment response evaluation

Response	Definition
CT response evaluation criteria according to RECIST 1.1	
CR	Disappearance of all lesions Reduction to <10 mm in short axis of any pathological lymph nodes (whether target or non-target) No new lesions
PR	At least a 30% decrease in SLD of target lesions, taking as reference the baseline SLD No new lesions
SD	Does not meet the criteria for CR, PR, or PD
PD	At least a 20% increase in SLD of target lesions, taking as reference the <i>smallest sum on study</i> and at least 5 mm absolute increase in SLD New lesions
Modified CT response evaluation criteria according to Choi	
CR	Disappearance of all lesions No new lesions
PR	A decrease in size ^a of $\geq 10\%$ or a decrease in tumor density (HU) $\geq 15\%$ on CT No new lesions No obvious progression of nonmeasurable disease
SD	Does not meet the criteria for CR, PR, or PD No symptomatic deterioration attributed to tumor progression
PD	An increase in tumor size of $\geq 10\%$ and does not meet criteria of PR by tumor density (HU) on CT New lesions New intratumoral nodules or increase in the size of the existing intratumoral nodules

CR complete response, PR partial response, HU Hounsfield unit, CT computed tomography, SD stable disease, PD progression of disease, RECIST Response Evaluation Criteria in Solid Tumors

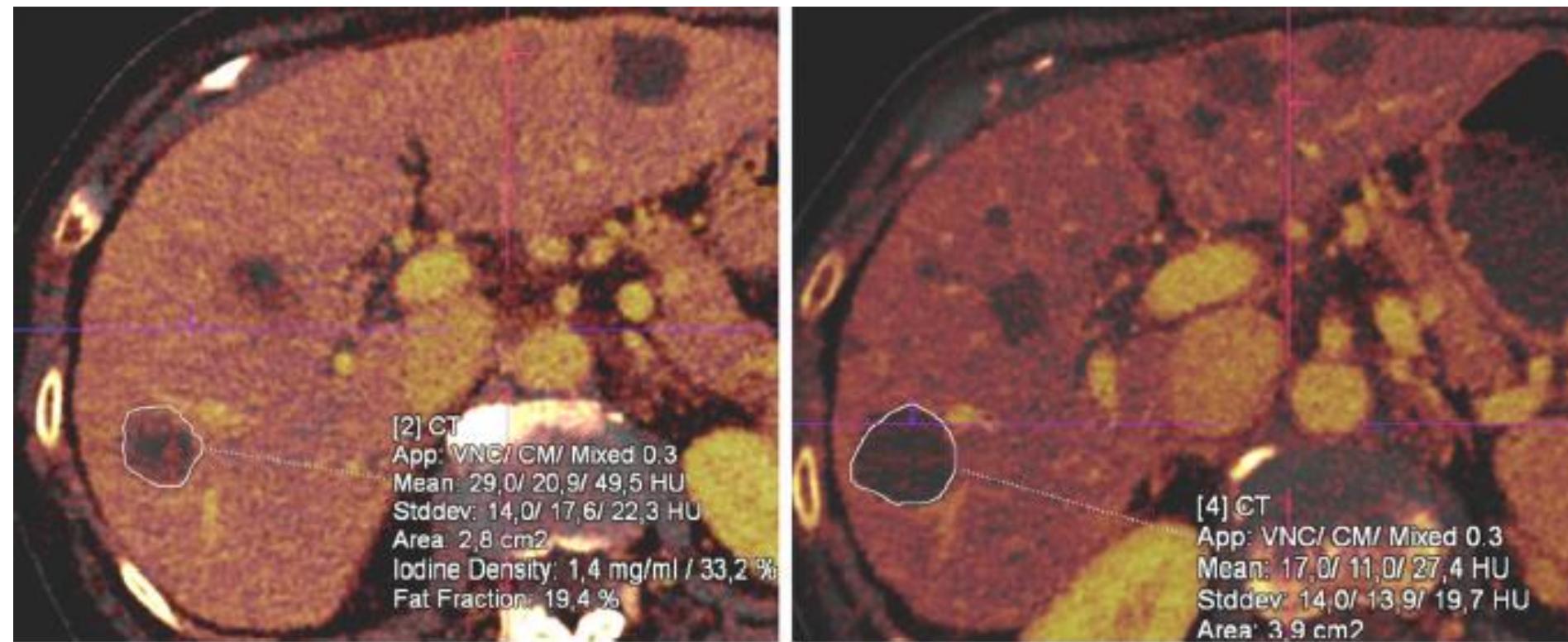
^a SLD The sum of longest diameters of target lesions as defined in RECIST

« New » CT criteria

- Size and number of lesions (RECIST + Choi)
- Importance and extent of contrast uptake
- Presence / absence of tumoral vessels
- Presence / absence of solid nodules

Choi et al ; AJR 2004 ; 183 : 1619-1628

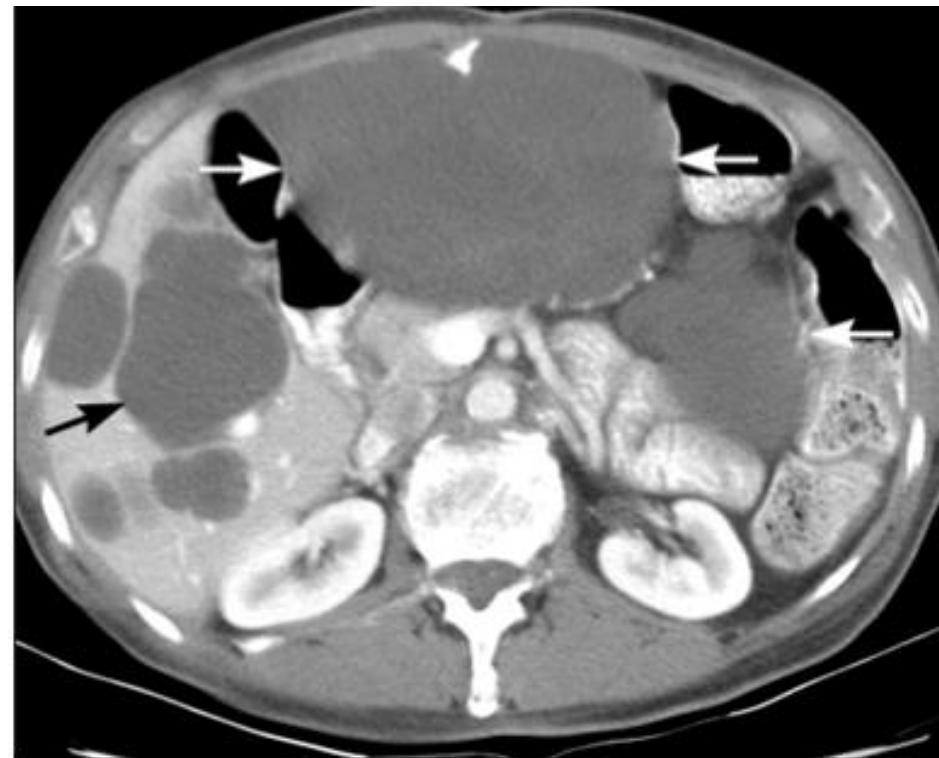
Importance and extent of contrast uptake Added value of post-processing in DECT



Antonia Dimitrakopoulou-schrauss et al ; Clin Transl Imaging (2017) 5 : 183 - 197

Tumoral vessels : high specificity but low sensibility

>>> mono-energetic imaging



Choi et al ; AJR 2004 ; 183 : 1619-1628

Tumoral nodules (relapse)

>>> mono-energetic imaging



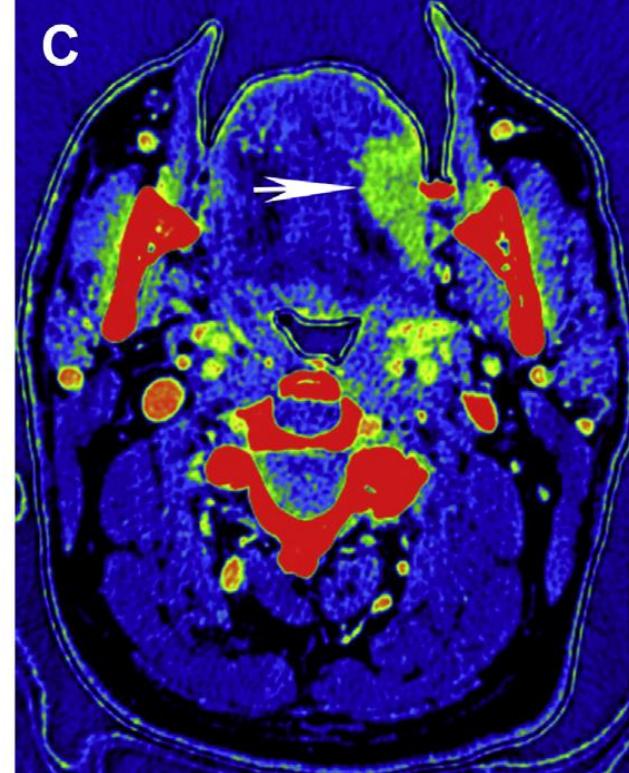
Antonia Dimitrakopoulou-strauss et al ; Clin Transl Imaging (2017) 5 : 183 - 197

Added value of DECT in head and neck neoplasia (squamous cell carcinoma)

65 keV

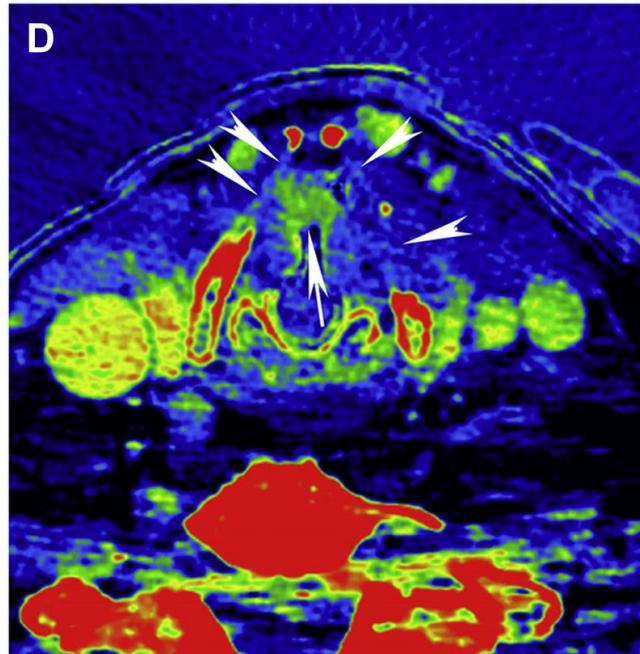
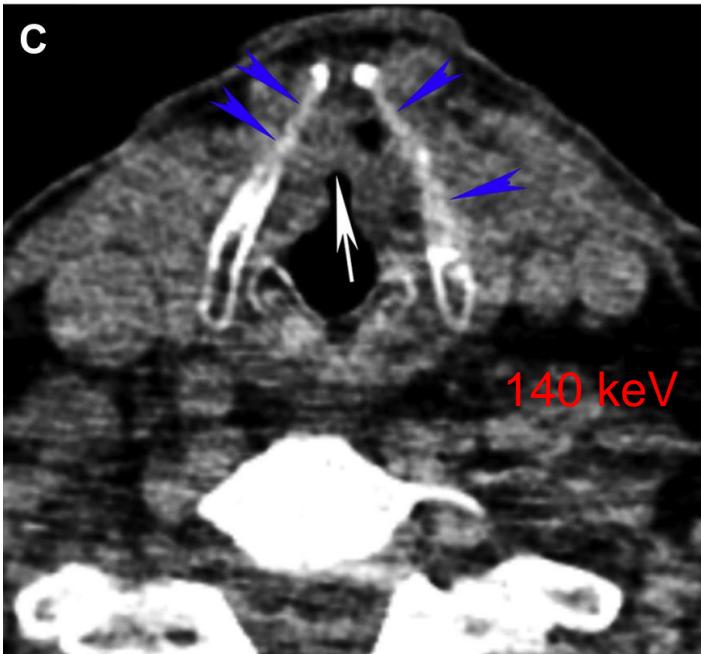
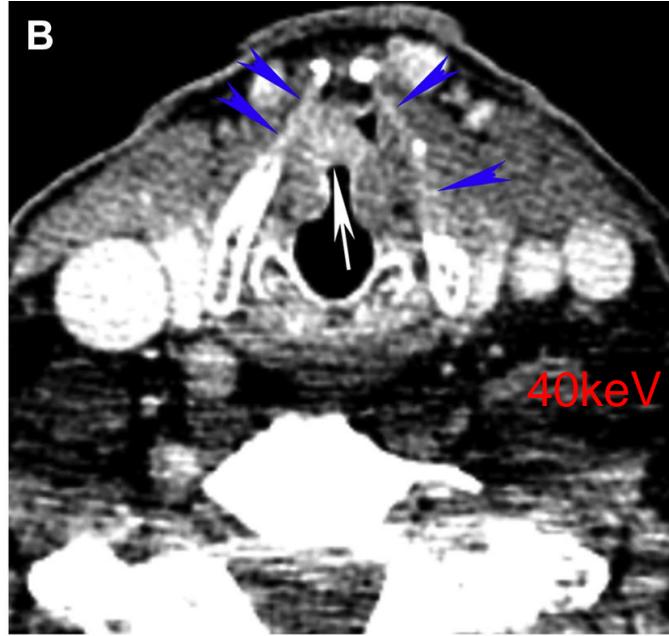
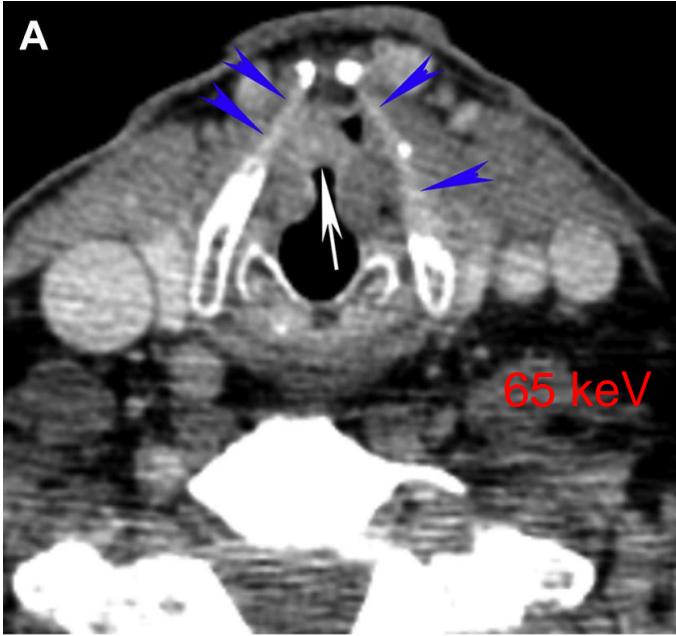
40 keV

Iodine Map

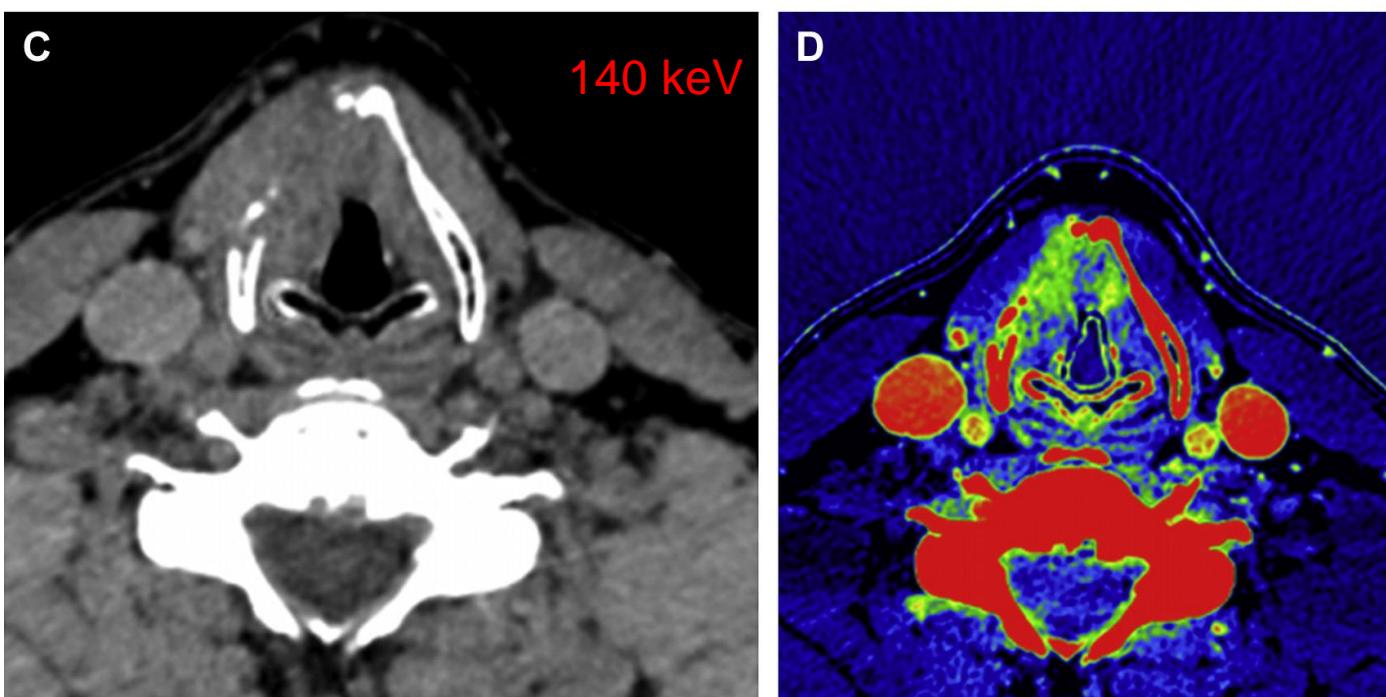
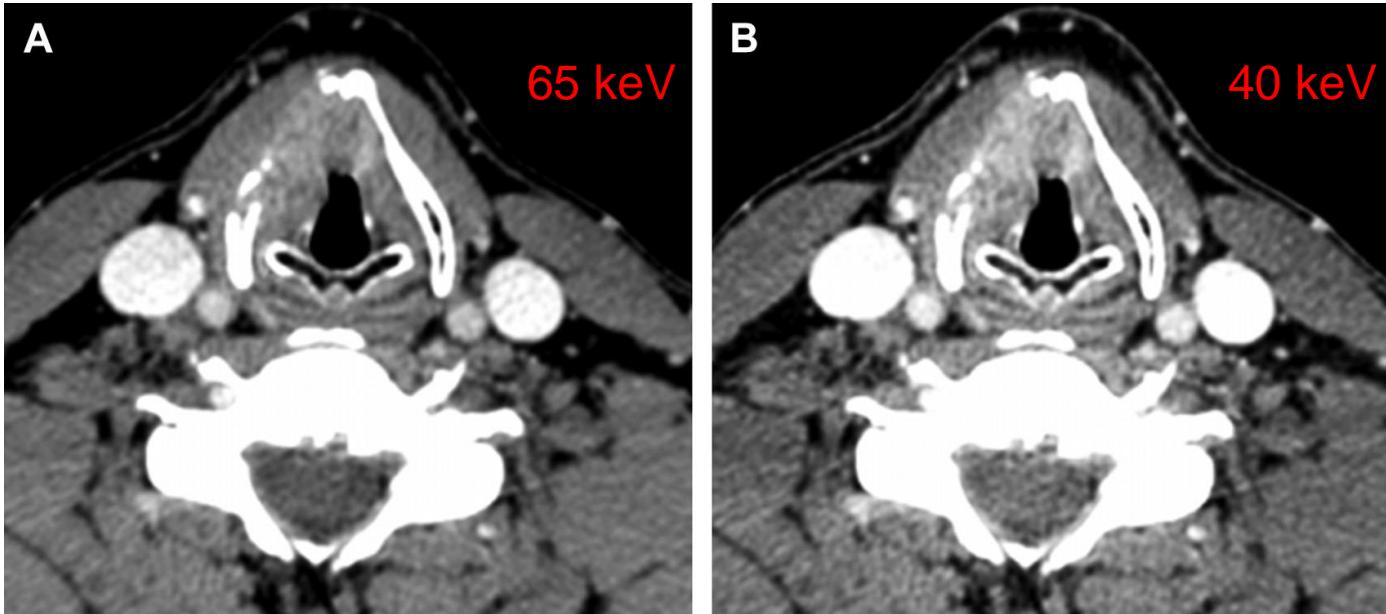


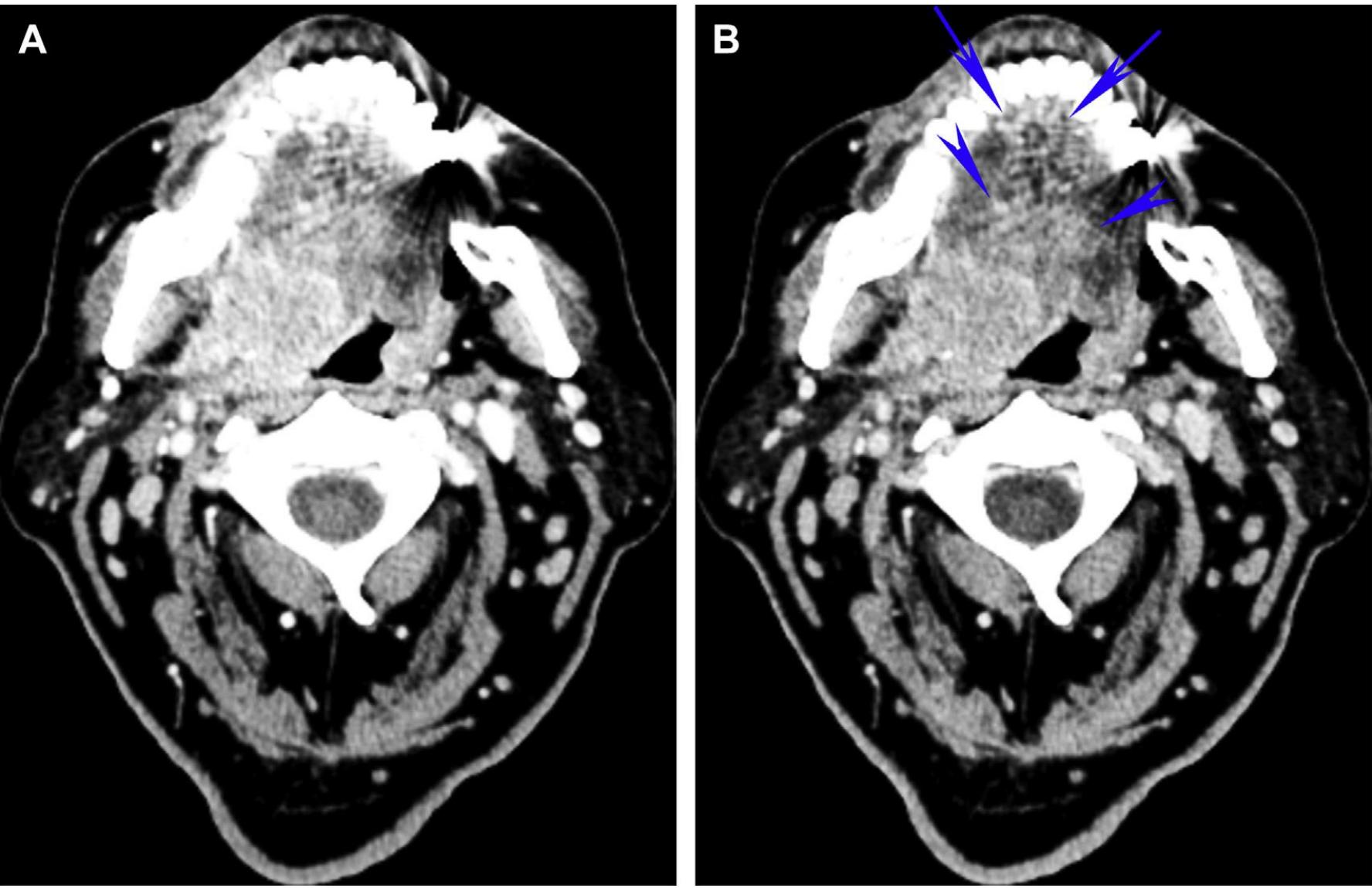
Reza Forghani et al ; Neuroimag Clin N Am 27 (2017) 445–459

Better tumor delination at low keV
">>>> planning of radiotherapy



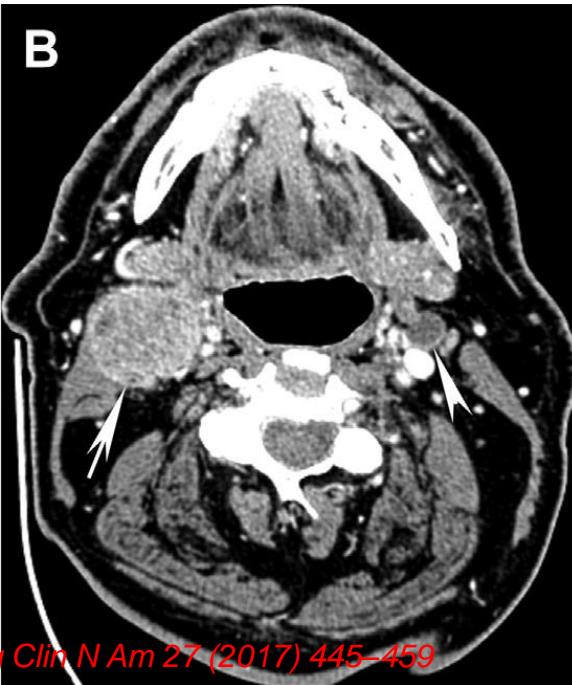
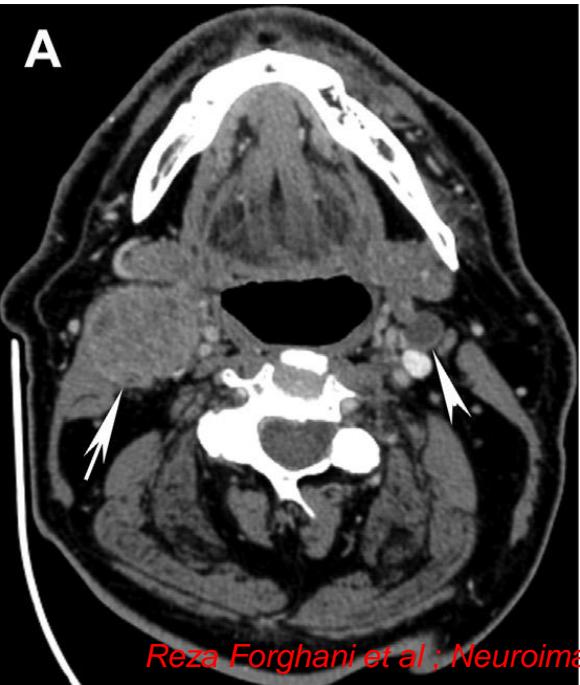
**Degree of invasion
of the non ossified
thyroid cartilage**





Reza Forghani et al ; Neuroimag Clin N Am 27 (2017) 445–459

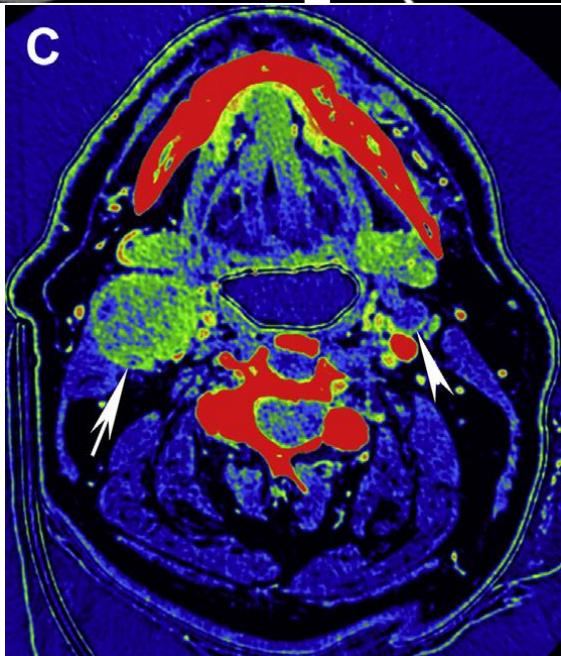
Dental artifact reduction at high energy (Dual energy + IMAR)



Reza Forghani et al : Neuroimag Clin N Am 27 (2017) 445–459

Lymph nodes

Better soft tissue contrast at low kV



Heterogeneous iodine distribution on iodine map

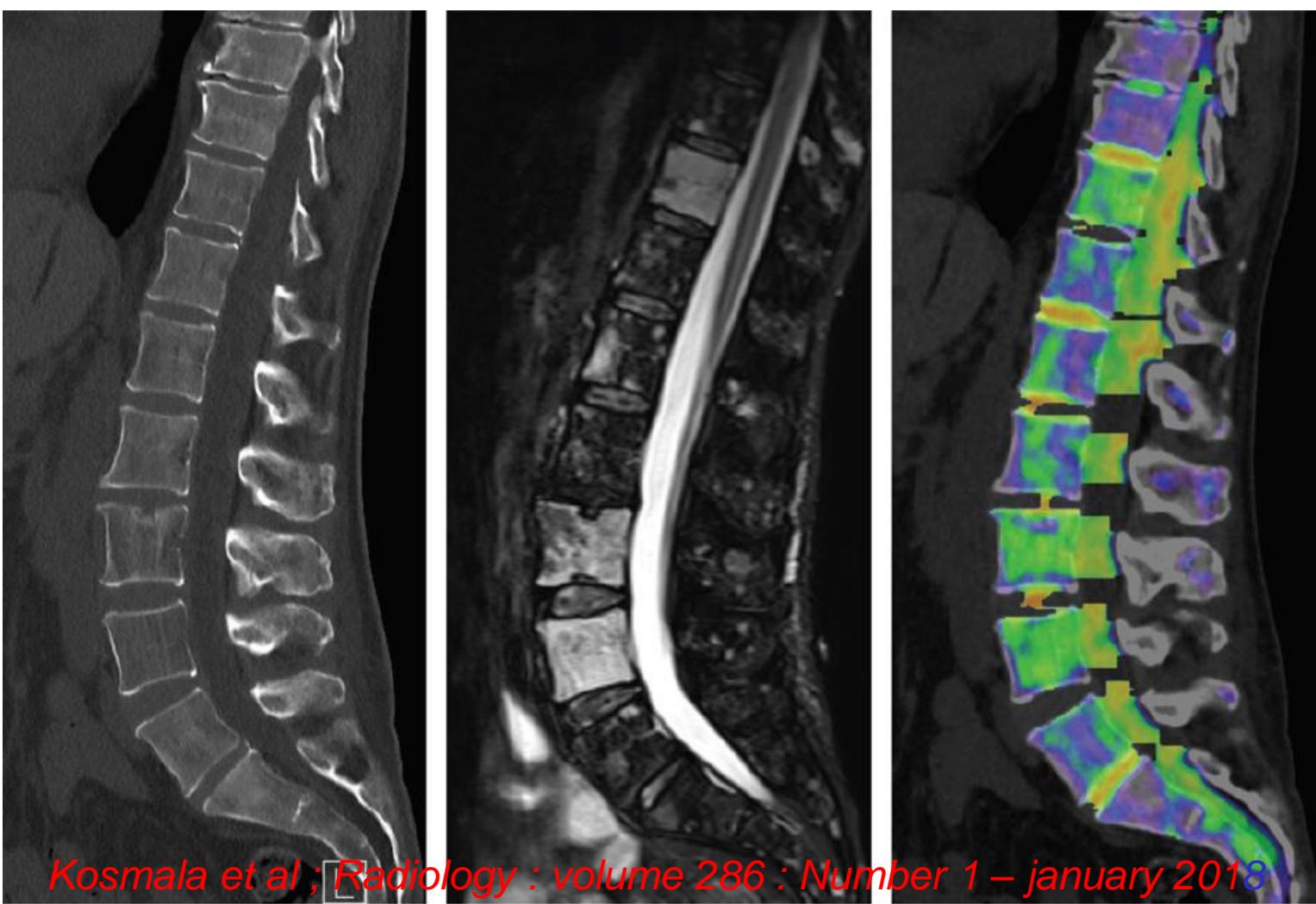
Virtual non calcium imaging (VNCa) and Multiple Myeloma

VNCa imaging

- First used to evaluate marrow edema in trauma
- Recently (2014), the International Myeloma Working Group advocated for replacement of conventional rx by more refined techniques.

Rajkumar et al ; Lancet Oncol 2014 : 15(12):e538-e548

- Total body CT
- Pet-CT
- MRI
- CT > MRI / PET-CT (osteolytic lesions < 5mm) but ...
lack of sensibility in the axial skeleton for non
osteolytic lesions >>> VNCa imaging ?



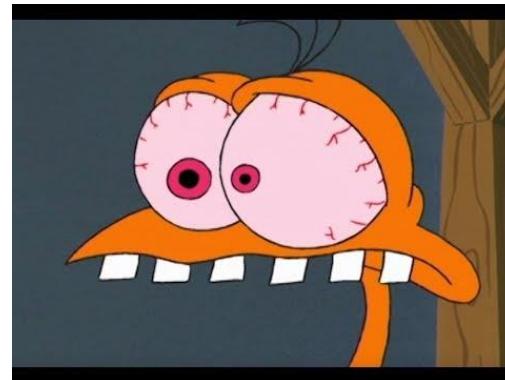
Kosmala et al ; Radiology : volume 286 : Number 1 – january 2018

34 patients (MM, MGUS), prospective, MRI = gold standard

- Visual analysis : S=91,3%, sp=90,9%, acc=91,2%, PPV=95,5%, NPV= 83,3%
- Cutoff -44,9UH : 93,3%, 92,4%, 92,7%, 84,3%, 96,9%

Conclusion

- DE = toolbox
 - VNC
 - VNCA
 - Mono E
 - Enhancement studies
 - Metal artifact reduction (DE CT + IMAR)
- Many informations !!! >>> good configuration



Somatom and the GoTop

**MAY
THE
FORCE
BE WITH
YOU**



Thank you for your listening !