

Harnessing Spectral Imaging CT

Scientific validation and revolutionary applications

Spectral imaging clinical proof



GE HealthCare was one of the pioneers in the introduction of Spectral Imaging and it has since emerged as a transformative technology, offering excellent value and clinical outcomes in CT. This document compiles a curated overview of research initiatives to showcase the latest advancements and clinical insights into spectral imaging on the Revolution™ CT and Apex platforms.

Since the launch of Spectral Imaging in 2008, we have significantly evolved our technology incorporating valuable feedback and learnings from the extensive research publications of our customers. This booklet contains an extract of the latest evidence supporting the adoption of spectral imaging into daily routine*.

Sophie Delsart
EMEA CT Clinical Marketing Leader

*The publications cited and represented in the following document are single center studies and varied by clinical indications, study protocols, and comparison methods. The results and conclusions obtained in these studies are only applicable to the specific studies cited and may not be generalizable or reproducible in your practice.



Spectral imaging clinical proof

ENT lesion detection

Low-Energy Virtual Monochromatic Dual-Energy Computed Tomography Images for the Evaluation of Head and Neck Squamous Cell Carcinoma: A Study of Tumor Visibility Compared With Single-Energy Computed Tomography and User Acceptance

Reza Forghani¹, Hillary Kelly, Eugene Yu, Manon Belair, Laurent Létourneau-Guillon, Huy Le, Francesca Proulx, Thomas Ong, Xianming Tan, Hugh D Curtin, Mark Levental

Affiliations expand | PMID: 28471869 DOI: 10.1097/RCT.0000000000000571

Abstract

Objective: Dual-energy computed tomography (CT) 40-keV virtual monochromatic images (VMIs) have been reported to improve visualization of head and neck squamous cell carcinoma, but a direct comparison to single-energy CT (SECT) is lacking, and there is debate regarding subjective user preference. We compared 40-keV VMIs with SECT and performed a subjective evaluation of their utility and acceptability for clinical use.

Methods: A total of 60 dual-energy CT and 60 SECT scans from 2 different institutions were evaluated. Tumor conspicuity was evaluated objectively using absolute and relative attenuation and subjectively by 3 head and neck specialists and 3 general radiologists.

Results: Tumors had significantly higher absolute and relative attenuation on 40-keV VMIs ($P < 0.0001$). Subjectively, the 40-keV VMIs improved visualization, with substantial (κ , 0.61-0.80) to almost perfect (κ , 0.81-1) interrater agreements.

Conclusions

The 40-keV VMIs improve tumor visibility objectively and subjectively both by head and neck specialists and general radiologists.

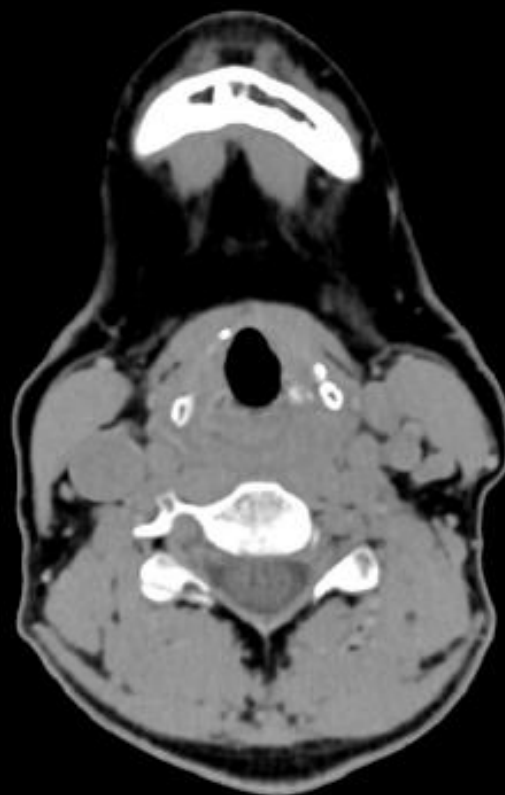


Know more

Excellent delineation of the tumor



MR



VUE



65 KeV Art 25"

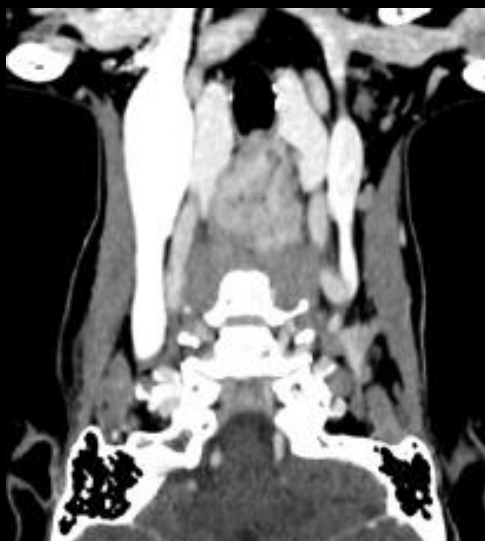


Iodine map

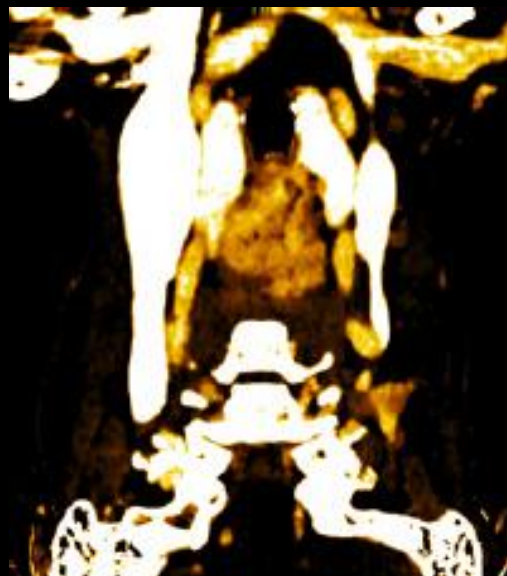
Images courtesy of Dr Clarisse Dromain, CHUV Lausanne - Switzerland

CTDIvol, mGy 14,80

Better delineation to mark out the boundaries of the tumor to guide Radiotherapy (RTH)



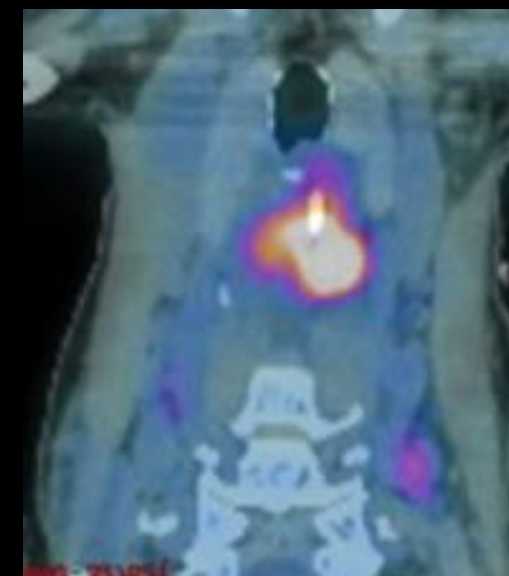
65 KeV Art 25''



Iodine map



RTH



RTH

Revolution™ APEX Platform

Images courtesy of Dr Clarisse Dromain, CHUV Lausanne - Switzerland

CTDIvol, mGy 14,80

Spectral imaging clinical proof

Thorax lesion characterization

Preliminary application of high-definition computed tomographic Gemstone Spectral Imaging in lung cancer

Guangli Wang¹, Chengqi Zhang, Mingying Li, Kai Deng, Wei Li

Affiliations expand | PMID: 24378884 DOI: 10.1097/RCT.0b013e3182a21633

Abstract

Rationale and objectives: To evaluate the feasibility of multiparameter quantitative measurement lung cancer by Gemstone Spectral Imaging (GSI) high-definition computed tomography.

Materials and methods: Seventy-seven patients who were found to have a lung mass or a nodule by CT plain scan for the first time received chest contrast CT scan with GSI mode on high-definition computed tomography. The GSI viewer was used to display the spectral curve, iodine-based images, water-based images, and 101 sets of monochromatic images of a selected region of interest from the relative homogeneous area of the mass or nodule. Iodine concentration, water concentration, spectral curve slope, and CT values at 40 keV of the region of interest were measured. Finally, 68 eligible patients were divided into a pneumonia group (n = 24) and a malignant tumor group (n = 44, including squamous carcinoma, n = 29, and adenocarcinoma, n = 15).

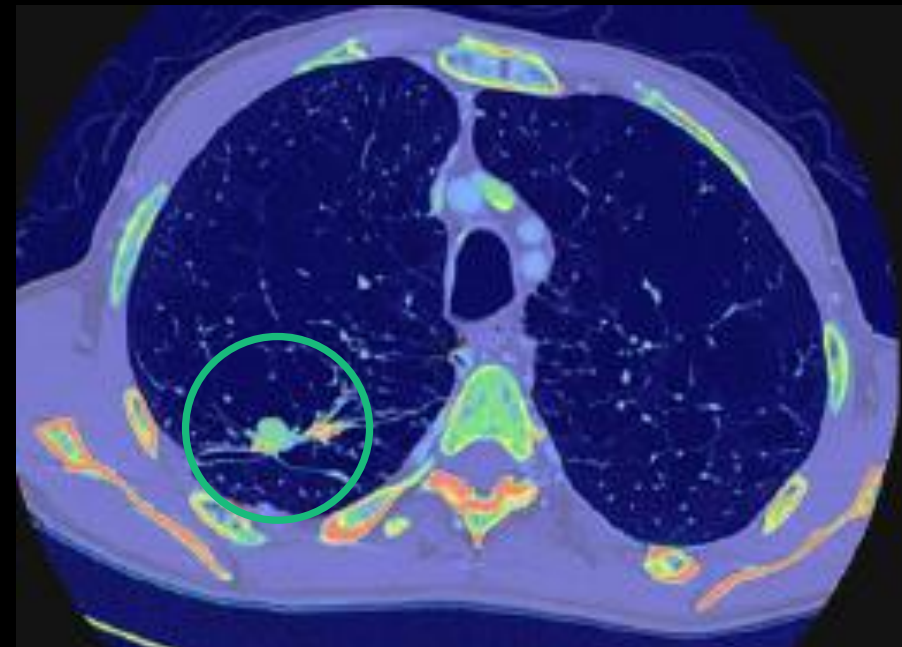
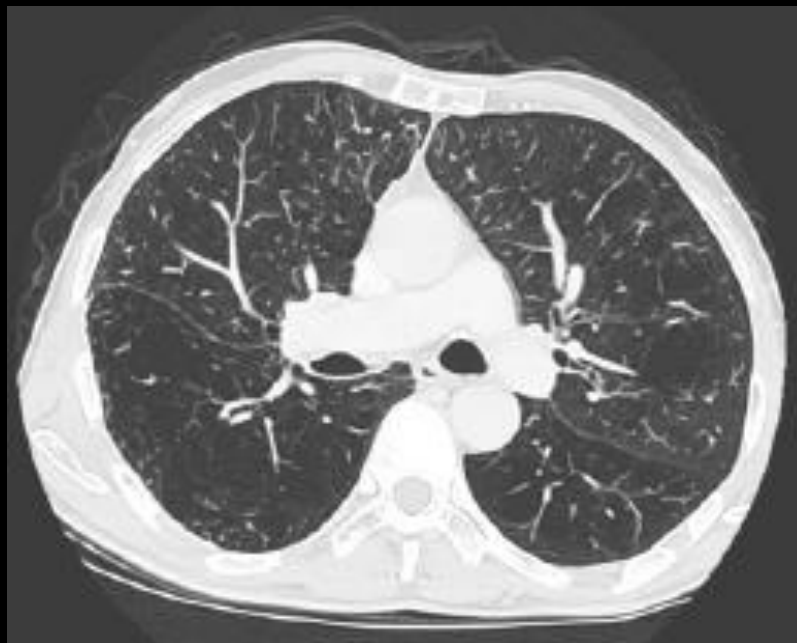
Results: Significant differences existed in iodine concentration (t = 6.459), spectral curve slope (t = 6.276), and CT values at 40 keV (t = 6.698) between the pneumonia group and the malignant tumor group (P < 0.05), as well as between squamous carcinoma and adenocarcinoma (t = 6.494, 5.634, 6.091, respectively, P < 0.05), whereas water concentrations were found to have no difference between the 2 groups (t = 0.082, P > 0.05) and between the 2 types of malignant tumors (t = 1.234, P > 0.05).

Conclusions

High-definition computed tomographic GSI technique might be helpful to differentiate lung cancer from lung benign lesions by providing qualitative and quantitative information.



Iodine map for nodule detection



Revolution™ APEX Platform

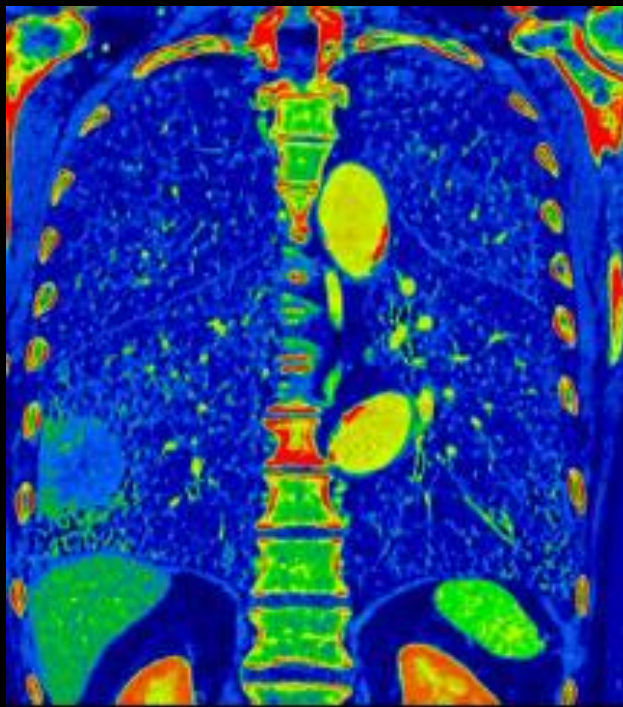
Images courtesy of Universitair Ziekenhuis Brussel, Belgium

CTDIvol 4 mGy

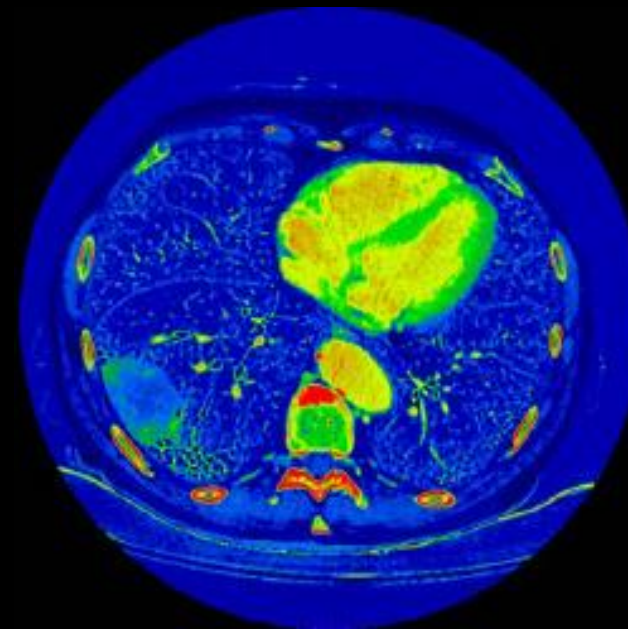
Lung lesion



70 keV



Iodine/Water map



Iodine/Water map

Revolution™ APEX Platform

Images courtesy of Universitair Ziekenhuis Brussel, Belgium

CTDIvol 4,5 mGy

Spectral imaging clinical proof

Liver lesion detection

Application of gemstone spectral imaging for efficacy evaluation in hepatocellular carcinoma after transarterial chemoembolization

Qi-Yu Liu¹, Chuan-Dong He¹, Ying Zhou¹, Dan Huang¹, Hua Lin¹, Zhong Wang¹, Dong Wang¹, Jin-Qiu Wang¹, Li-Ping Liao¹

Affiliations expand | PMID: 27004002 PMCID: PMC4790000 DOI: 10.3748/wjg.v22.i11.3242

Abstract

Aim: To assess the value of gemstone spectral imaging (GSI) in efficacy evaluation in hepatocellular cancer (HCC) after transcatheter arterial chemoembolization (TACE) treatment.

Methods: Thirty patients with HCC underwent GSI, including nonenhanced, arterial, portalvenous and delayed phase scans, after TACE treatment. Arterial phase images were acquired with GSI for reconstruction of virtual nonenhanced images and color overlay images. Digital subtraction angiography (DSA) was performed in all these patients. Two blinded and independent readers evaluated the data in two reading sessions; standard nonenhanced, arterial, portalvenous, and delayed phase images were read in session A, and the optimal monochromatic images, iodine/water based images and spectrum features were read in session B. Sensitivity and specificity were calculated with the DSA data as the reference standard. The sensitivity and specificity were compared using the χ^2 test.

Results: DSA revealed 154 lesions in 30 patients, and 100 of them had blood supply. Overall sensitivity and specificity were 72% (72/100) and 77.8% (42/54) for session A, and 97% (97/100) and 94.4% (51/54) for session B, respectively. The sensitivity and specificity of the two reading sessions were significantly different ($\chi^2 = 23.04$, $\chi^2 = 7.11$, $P < 0.05$).

Conclusions

Compared with conventional CT, GSI could significantly improve the detection of small and multiple lesions without increasing the radiation dose. Based on spectrum features, GSI could assess tumor homogeneity and more accurately identify residual tumors and recurrent or metastatic lesions during efficacy evaluation and follow-up in HCC after TACE treatment.



Assessment of tumor homogeneity and identification of residual tumors



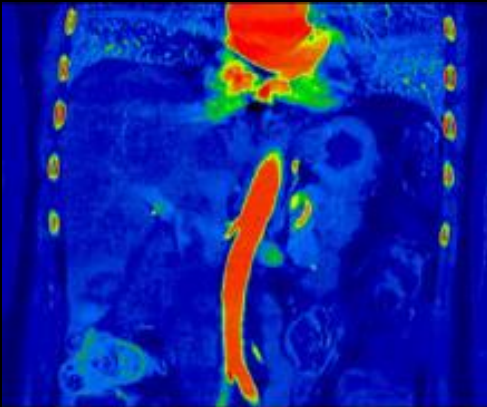
Without contrast



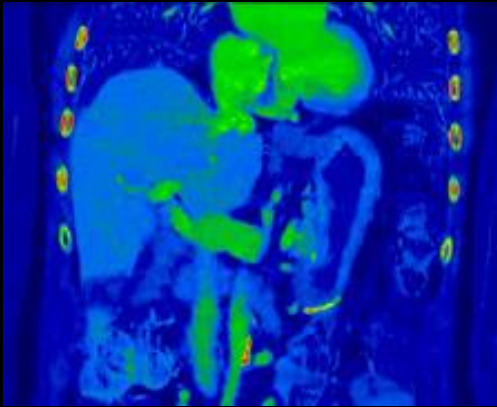
Virtual Unenhanced



Arterial - 70 keV



Arterial – Iodine (Water) map



Venous – Iodine (Water) map

Apex Select Spectral abdo

Images courtesy of Universitair Ziekenhuis Brussel, Belgium

CTDIvol 2.4/4.6/3.5 mGy

Spectral imaging clinical proof

Liver lesion detection

Virtual unenhanced imaging of the liver derived from 160-mm rapid-switching dual-energy CT (rsDECT): Comparison of the accuracy of attenuation values and solid liver lesion conspicuity with native unenhanced images

Maxime Lacroix ¹, Sébastien Mulé ², Edouard Herin ³, Frédéric Pigneur ³, Philippe Richard ⁴, Benhalima Zegai ³, Laurence Baranes ³, Marjan Djabbari ³, Francesco Brunetti ⁵, Nicola de'Angelis ⁶, Alexis Laurent ⁶, Vania Tacher ³, Hicham Kobeiter ⁷, Alain Luciani ²

Affiliations expand | PMID: 33166833 DOI: 10.1016/j.ejrad.2020.109387

Abstract

Objectives: To evaluate the reliability of attenuation values of the liver parenchyma and focal liver lesions on virtual unenhanced images from arterial (VUEart) and portal venous phases (VUEport) compared to native unenhanced (NU) attenuation values in patients referred for assessment of malignant liver lesions.

Methods: Seventy-three patients with confirmed primary or metastatic liver tumors who underwent a multiphase contrast-enhanced rapid-switching kVp dual-energy CT (rsDECT) were included in this IRB-approved retrospective study. Both qualitative and quantitative analyses - including the lesion-to-liver contrast-to-noise ratio (LL-CNR) - were performed and compared between NU and both VUEart and VUEport images.

Results: The mean liver attenuation values were significantly lower in VUEart images (56.7 ± 6.7 HU) than in NU images (59.6 ± 7.5 HU, $p = 0.008$), and were comparable between VUEart and VUEport images (57.9 ± 6 UH, $p = 0.38$) and between VUEport and NU images ($p = 0.051$). The mean liver lesions attenuation values were comparable between NU, VUEart and VUEport images ($p = 0.60$). Strong and significant correlations values were found both in liver lesions and tumor-free parenchyma ($r = 0.82-0.91$, $p < 0.01$). The mean LL-CNR was significantly higher in VUEart and VUEport images than in NU images (1.7 ± 1 and 1.6 ± 1.1 vs 0.9 ± 0.6 ; $p < 0.001$), but was comparable between VUEart and VUEport images ($p > 0.9$). Lesion conspicuity was significantly higher in VUEport images than in NU images ($p < 0.001$).

Conclusions

VUEport images derived from 3rd generation rsDECT could confidently replace NU images in patients undergoing assessment for malignant liver lesions. These images provide comparable attenuation values in both liver lesions and liver parenchyma while reducing the radiation dose and scanning time.



Patient history

75 year old male patient

Liver cirrhosis with liver mass identified on US

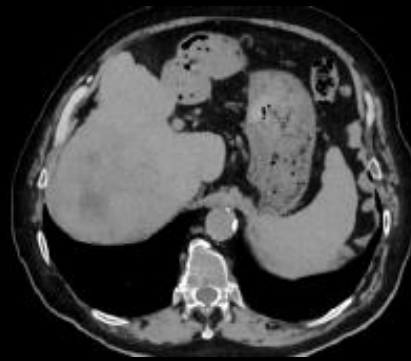
Thorax Abdomen and Pelvic CT prior to liver resection

Scanning

4 phase helical CT including 2 arterial phase, Portal Venous Phase and delayed phase as per LiRADS 2018 recommendations

Conclusion

Heterogeneous right lobe liver mass with Arterial Phase Hyperenhancement and Washout: LiRADS 5 Mass, accounting for potential HCC



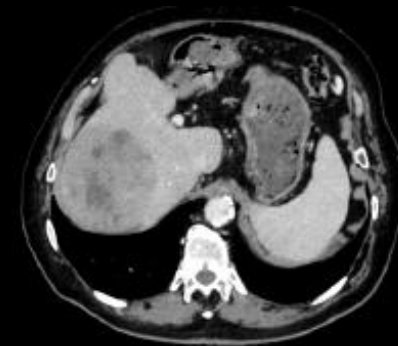
VUE



50 KeV Art 25"



50 KeV Art 35"



50 KeV Portal



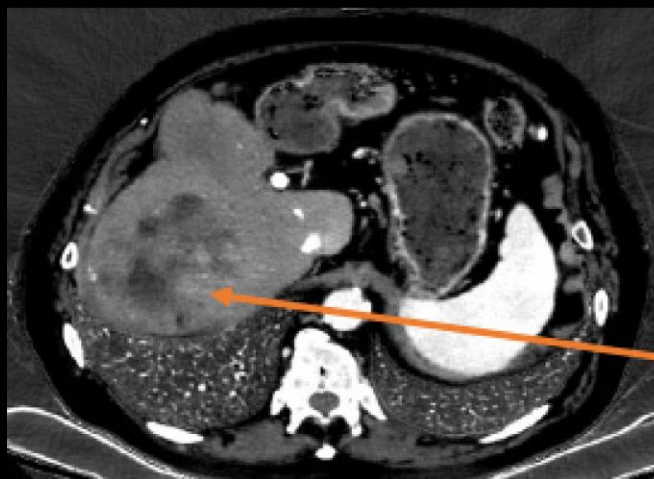
50 KeV Delayed

Images courtesy of Pr A Luciani CHU Henri Mondor, UPEC, APHP

4 phases CTDIvol 12,15 mGy

Additional functional information, obtained routinely

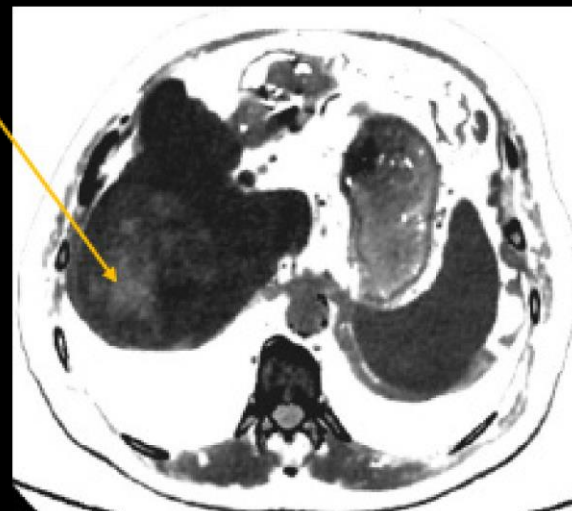
- Relative Iodine Concentration within liver mass
- Probable fat-in mass content, confirm hepatocellular origin of this LiRADS5 liver mass



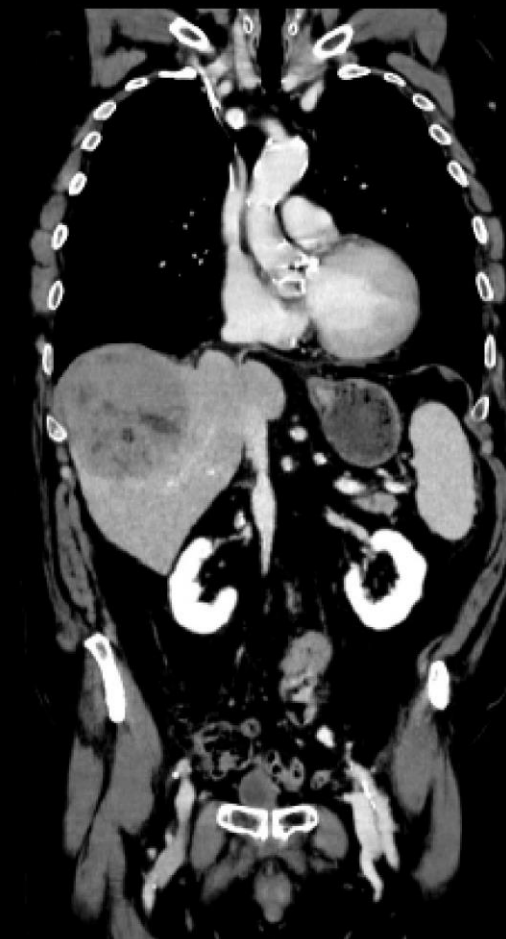
Iodine Map

Increased fat
over liver
content on fat-
maps

Increased relative
iodine
concentration
within mass on
arterial phase CT



Fat Map



4 phases CTDIvol 12,15 mGy

Spectral imaging clinical proof

Pancreatic adenocarcinoma

Role of rapid kV-switching dual-energy CT in assessment of post-surgical local recurrence of pancreatic adenocarcinoma

Anushri Parakh¹, Manuel Patino¹, Daniela Muenzel^{1,2}, Avinash Kambadakone¹, Dushyant V Sahani³

Affiliations expand | PMID: 29138890 DOI: 10.1007/s00261-017-1390-2

Abstract

Purpose: The purpose of this study is to evaluate the performance of material-specific iodine (MS-I) images generated by rapid kV-switching single-source dual-energy computed tomography (rsDECT) for distinguishing post-operative changes from local tumor recurrence in patients on follow-up for pancreatic adenocarcinoma after surgical resection.

Methods: In this IRB-approved HIPPA-compliant study, retrospective review of 51 patients who underwent surgical resection of pancreatic adenocarcinoma was conducted and were followed up using contrast-enhanced rsDECT (Discovery CT 750HD, GE Healthcare, Milwaukee, WI). Independent qualitative assessment for presence of local tumor recurrence was performed by two radiologists who evaluated 65 keV (single-energy CT-equivalent interpretation) and 65 keV with MS-I (rsDECT interpretation) in separate sessions. Quantitative analysis of Hounsfield unit (HU, on 65 keV) and normalized iodine concentration (NIC on MS-I images; iodine concentration ratio in post-operative tissue to aorta) was measured. Follow-up imaging, temporal change of CEA and CA 19-9 or biopsy served as reference standard for presence and absence of local recurrence. Sensitivity and specificity of readers and quantitative parameters was calculated and receiver operating characteristic curves and Fisher's exact test were generated. A p value < 0.05 was considered statistically significant.

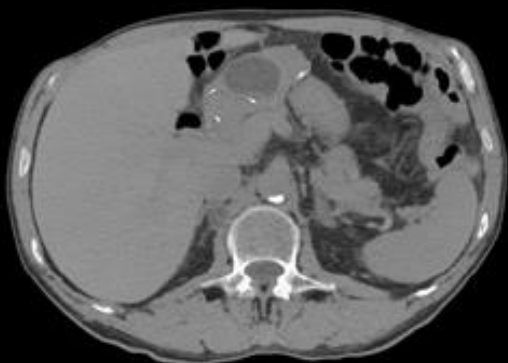
Results: A total of 51 patients (27 females, 24 males) with mean age of 64 years built the final cohort. Local recurrence was absent in 23 (Group A) and present in 28 (Group B) patients. The follow-up imaging was performed within 7 months of rsDECT. For both readers, the addition of MS-I increased the specificity for tissue characterization and improved reader confidence as compared to 65 keV (specificity: 80% and 56%, respectively) images alone. Quantitative analysis revealed a significantly lower NIC (0.28 vs. 0.35; $p < 0.05$) for non-recurrent tissue. However, HU was not significantly different for non-recurrent and recurrent tissue (0.63 vs. 0.70; $p > 0.05$).

Conclusions

In inherently complex cases of post-operative pancreatic adenocarcinoma, MS-I images from rsDECT can be a useful adjunct to conventional scans in characterizing loco-regional soft tissue.



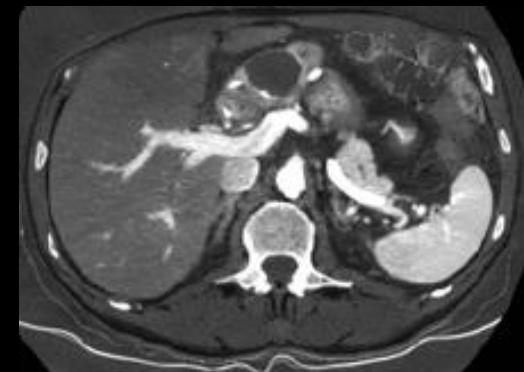
Pancreas TU w Drainage Ductus Pancreaticus 1/2



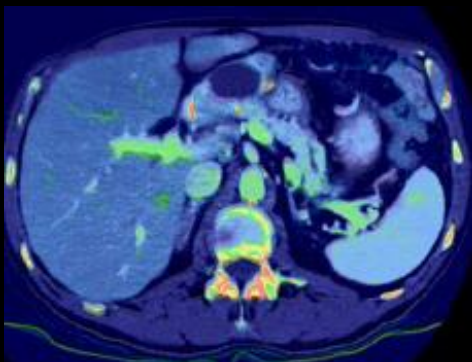
VUE 2mm



art. 50 keV Mono 2mm



art. MD Iodine (Water) 2mm



Merged art. MD Iodine w 50 keV Mono



ven. 50 keV Mono 2mm



ven. 50 keV Mono MIP

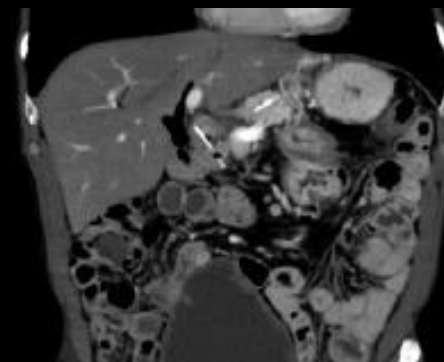
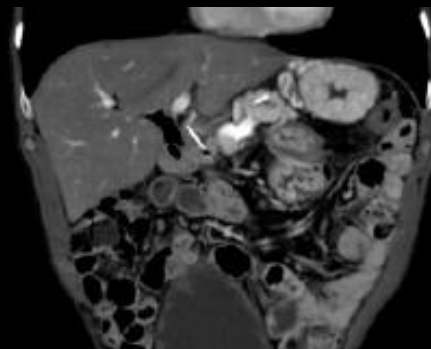
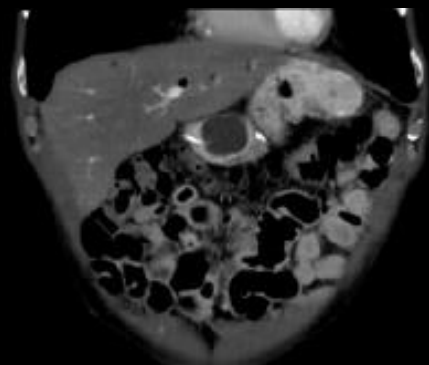
CT Revolution™ APEX TF

Image courtesy of Landeskrankenhaus Hall i. Tirol (Austria)

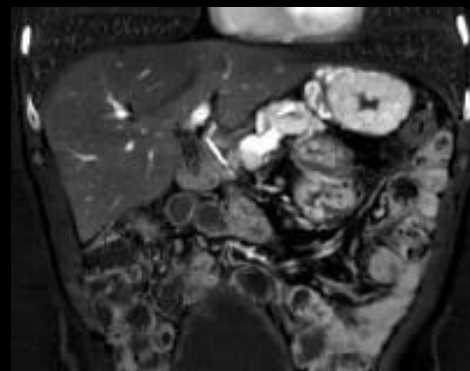
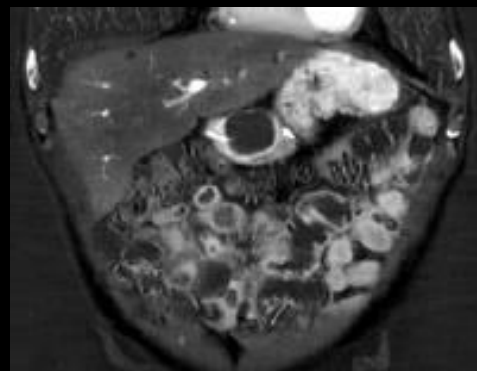
DLP 251 / 557 mGy-cm

Pancreas TU w Drainage Ductus Pancreaticus 2/2

art. 50 keV Mono 5mm



art. MD Iodine 5mm



CT Revolution™ APEX TF

Image courtesy of Landeskrankenhaus Hall i. Tirol (Austria)

DLP 251 / 557 mGy-cm

Pancreas Tumor stadium III - Liver Metastasis segment 5 - Partial thrombus portal vein



art. 50 keV Mono 3mm



art. 50 keV Mono 3mm



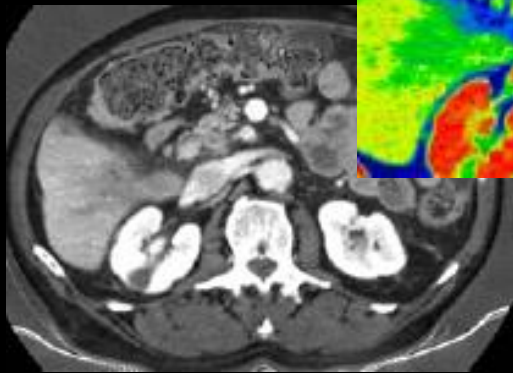
ven. 50 keV Mono 3mm



art. MD Iodine 3mm



art. MD Iodine 3mm



ven. MD Iodine 3mm

CT Revolution™ APEX TF

Image courtesy of Landeskrankenhaus Hall i. Tirol (Austria)

DLP 248/582 mGy-cm

Spectral imaging clinical proof

Renal lesion characterization

Characterization of Small Focal Renal Lesions: Diagnostic Accuracy with Single-Phase Contrast-enhanced Dual-Energy CT with Material Attenuation Analysis Compared with Conventional Attenuation Measurements

Daniele Marin ¹, Drew Davis ¹, Kingshuk Roy Choudhury ¹, Bhavik Patel ¹, Rajan T Gupta ¹, Achille Mileto ¹, Rendon C Nelson ¹

Affiliations expand | PMID: 28353408 DOI: 10.1148/radiol.2017161872

Abstract

Purpose To determine whether single-phase contrast material-enhanced dual-energy material attenuation analysis improves the characterization of small (1-4 cm) renal lesions compared with conventional attenuation measurements by using histopathologic analysis and follow-up imaging as the clinical reference standards. **Materials and Methods** In this retrospective, HIPAA-compliant, institutional review board-approved study, 136 consecutive patients (95 men and 41 women; mean age, 54 years) with 144 renal lesions (111 benign, 33 malignant) measuring 1-4 cm underwent single-energy unenhanced and contrast-enhanced dual-energy computed tomography (CT) of the abdomen. For each renal lesion, attenuation measurements were obtained; attenuation change of greater than or equal to 15 HU was considered evidence of enhancement. Dual-energy attenuation measurements were also obtained by using iodine-water, water-iodine, calcium-water, and water-calcium material basis pairs. Mean lesion attenuation values and material densities were compared between benign and malignant renal lesions by using the two-sample t test. Diagnostic accuracy of attenuation measurements and dual-energy material densities was assessed and validated by using 10-fold cross-validation to limit the effect of optimistic bias. **Results** By using cross-validated optimal thresholds at 100% sensitivity, iodine-water material attenuation images significantly improved specificity for differentiating between benign and malignant renal lesions compared with conventional enhancement measurements (93% [103 of 111]; 95% confidence interval: 86%, 97%; vs 81% [90 of 111]; 95% confidence interval: 73%, 88%) ($P = .02$). Sensitivity with iodine-water and calcium-water material attenuation images was also higher than that with conventional enhancement measurements, although the difference was not statistically significant.

Conclusions

Contrast-enhanced dual-energy CT with material attenuation analysis improves specificity for characterization of small (1-4 cm) renal lesions compared with conventional attenuation measurements.



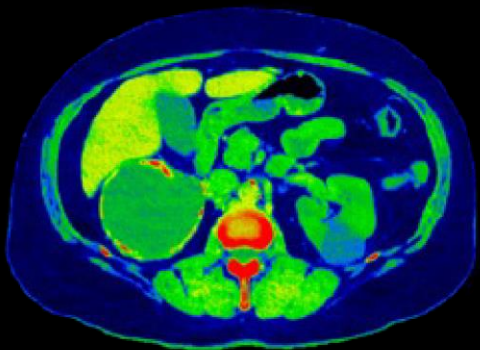
Know more

Spectral Abdomen & Pelvis – Renal

Renal Simple cyst DLP 353 Iodine (W) is negative with no iodine in the cysts within kidney the Water(I) shows no Haemorrhage within the cysts which would appear white in the Water(I) image.



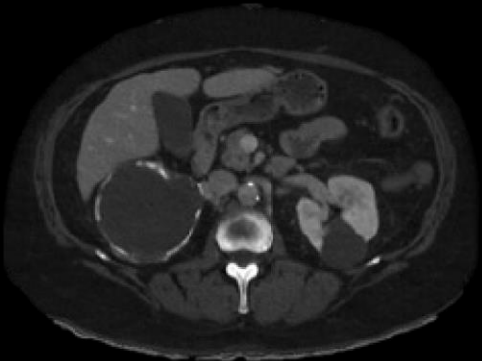
Water(I) MD 3mm



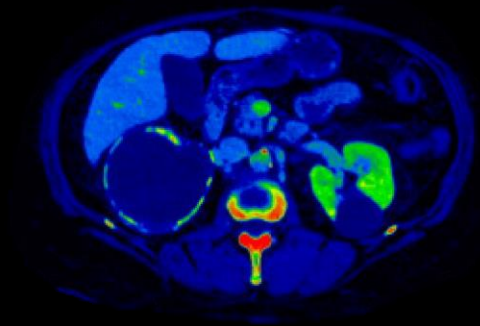
Water(I) MD 3mm + colour overlay



VNC 3mm



Iodine(W) MD 3mm



Iodine(W) MD 3mm + colour overlay



55keV Mono

Image courtesy of Slagelse Sygehus - Denmark

DLP 353 mGy-cm

Spectral imaging clinical proof

CT angiography

Substantial iodine volume load reduction in CT angiography with dual-energy imaging: insights from a pilot randomized study

Patricia Carrascosa ¹, Carlos Capunay, Gaston A Rodriguez-Granillo, Alejandro Deviggiano, Javier Vallejos, Jonathon A Leipsic

Affiliations expand | PMID: 25053514 DOI: 10.1007/s10554-014-0501-1

Abstract

We explored whether dual-energy computed tomography (DECT) can allow a significant reduction in iodinated contrast volume during computed tomography angiography (CTA) without hampering image quality or assessability. We prospectively randomized patients clinically referred to CTA to single energy computed tomography (SECT) with full iodine volume load (group A), DECT with 50 % iodine volume load (group B), DECT with 40 % iodine volume load (group C), and DECT with 30 % iodine volume load (group D); and compared image quality and assessability. Eighty patients were enrolled and prospectively randomized. The mean age was 61.7 ± 15.0 years and 56 (71 %) patients were male. The demographical characteristics, body mass index, or mean radiation dose did not differ between groups. Significant reductions in total contrast volume were achieved in groups B, C, and D; with mean administrated contrast volumes of 90.3 ± 10.1 , 39.5 ± 4.6 , 28.3 ± 6.5 , and 23.9 ± 6.0 mL, respectively, in groups A to D ($p < 0.0001$). With regard to image quality, no significant decrease in the Likert scale was observed with reductions of up to 60 % of the contrast volume (groups B and C). DECT at 50-60 keV in association with up to 60 % iodine load reduction, allowed similar signal density, image noise, and signal to noise ratio that SECT imaging with full iodine load. In this pilot, prospective, randomized study, dual energy CTA with up to 60 % iodine volume load reduction provided similar image quality and assessability than full iodine load with conventional SECT imaging.

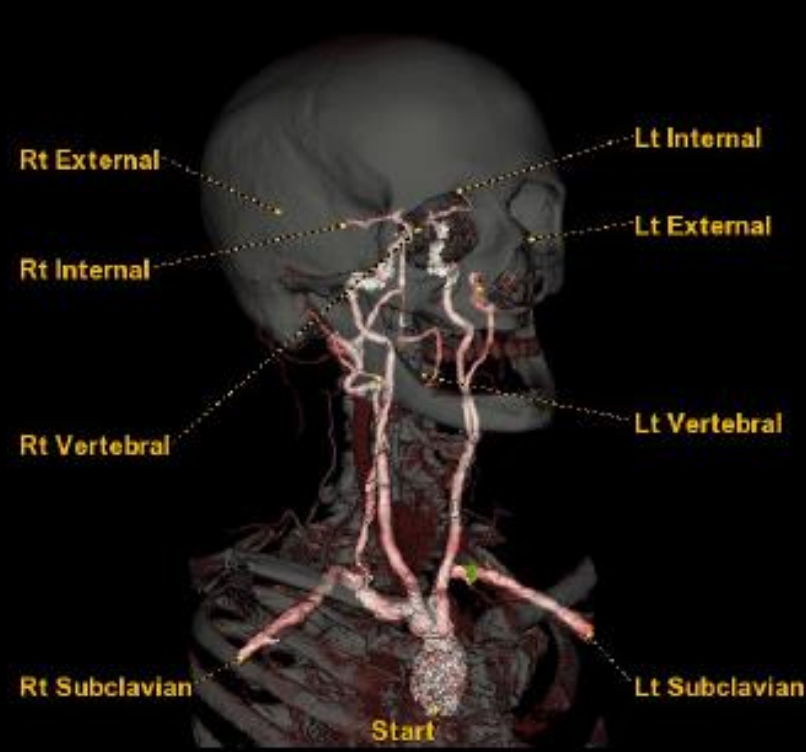
Conclusions

Potential reduction up to 60% of the contrast volume allowed similar signal density, image noise and SNR

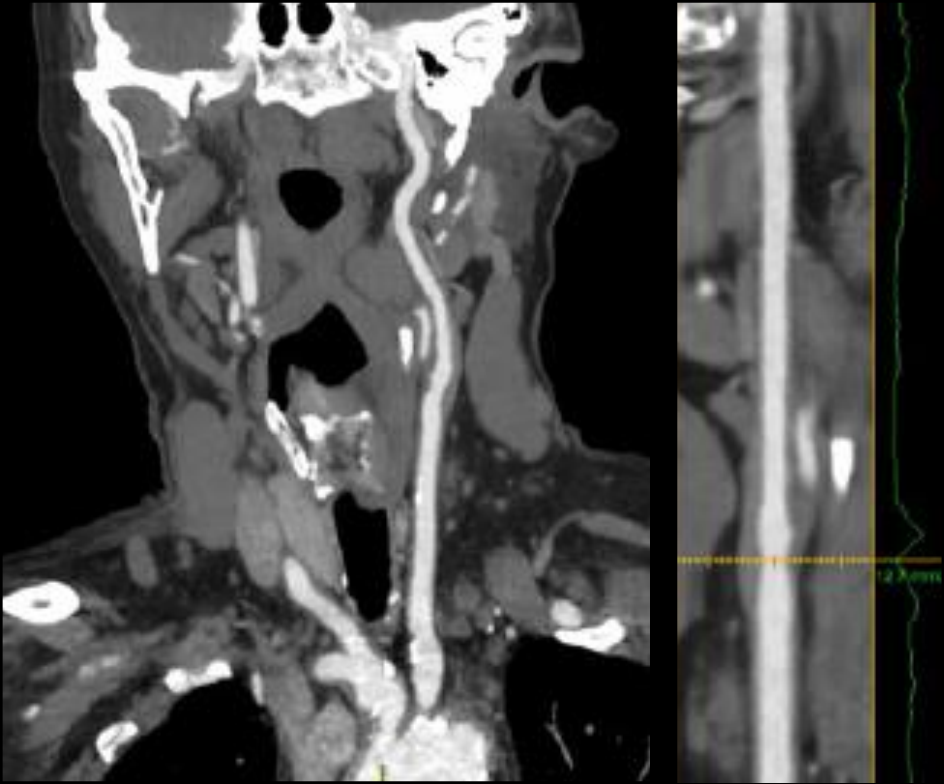


Carotids with 30cc CM

History	Vertigo
Findings	Occlusion of Left vertebral artery Wall thickening of left internal carotid



Volume Illumination – Automatic labbels



Monochromatic 55keV – 30cc CM-
Thicker wall of left internal carotid

Images courtesy of Universitair Ziekenhuis Brussel, Belgium

CTDI 8 mGy

Spectral Pulmonary Angio

History:

COVID 19 – Long COVID Follow up
Pneumonitis

71% Reduction in IV contrast



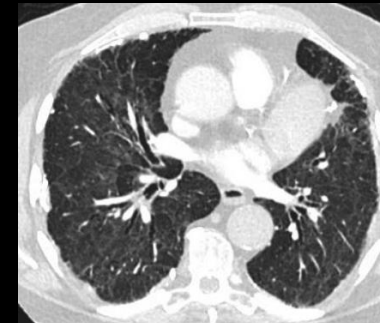
SECT - 4cms CT – 100kVp
ROI - Av. 533 HU
Injection Protocol 70mls @
4.5mls/s & 50mls Saline @
4.5mls/s



DECT – Apex Spectral
100kVp Like
ROI – 355 HU
Injection Protocol 20mls @ 2.5mls/s
& 50mls Saline @2.5mls/s



40keV Monochromatic
ROI - Av. 996 HU



Apex Elite

Image courtesy of Derriford Hospital – Plymouth Hospitals NHS Trust

Spectral Pulmonary Angio

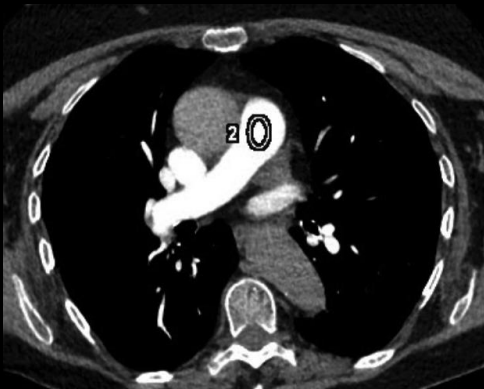
History:

Multiple small subsegmental pulmonary emboli with subtle mosaic perfusion of the lung parenchyma.
No central pulmonary emboli or CT features of right heart strain.
Long COVID follow-up

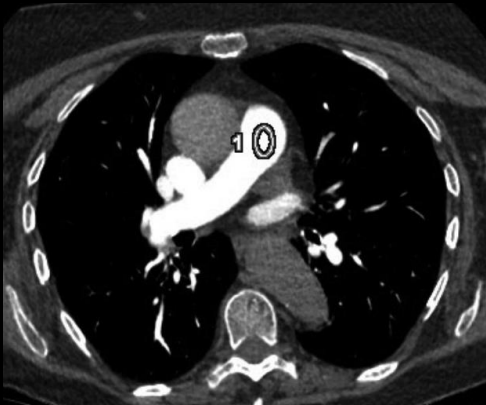
60% Reduction in IV contrast



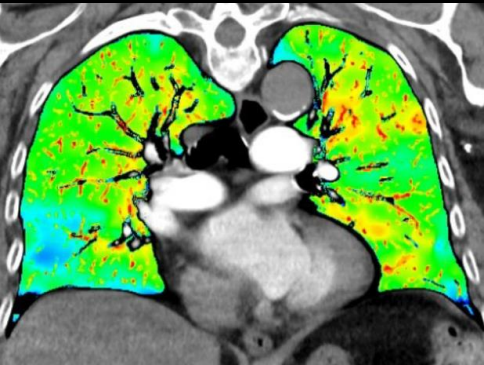
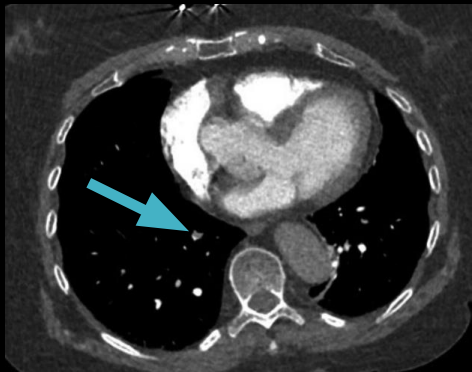
SECT – Rev CT (arms down) – 100kVp
ROI - Av. 518 HU
Injection Protocol 50mls @ 5mls/s & 50mls Saline @ 5mls/s



DECT – Apex Spectral (arms down) 100kVp Like **ROI – 280 HU** Injection Protocol 20mls @ 2.5mls/s & 50mls Saline @2.5mls/s



40keV Monochromatic **ROI - Av. 750 HU**



Apex Elite

Image courtesy of Derriford Hospital – Plymouth Hospitals NHS Trust

Spectral imaging clinical proof

Bone lesion detection

Improved Diagnostic Accuracy of Bone Metastasis Detection by Water-HAP Associated to Non-Contrast CT

Yoshinobu Ishiwata¹, * Yojiro Hieda², Soichiro Kaki², Shinjiro Aso¹, Keiichi Horie¹, Yusuke Kobayashi³, Motoki Nakamura³, Kazuhiko Yamada², Tsuneo Yamashiro¹ and Daisuke Utsunomiya¹

Affiliations expand | PMID: 33092274 PMCID: PMC7589875 DOI: 10.3390/diagnostics10100853

Abstract

We examined whether water-hydroxyapatite (HAP) images improve the diagnostic accuracy of bone metastasis compared with non-contrast CT alone. We retrospectively evaluated dual-energy computed tomography (DECT) images of 83 cancer patients (bone metastasis, 31; without bone metastasis, 52) from May 2018 to June 2019. Initially, two evaluators examined for bone metastasis on conventional CT images. In the second session, both CT and CT images plus water-HAP images on DECT. The confidence of bone metastasis was scored from 1 (benign) to 5 (malignant). The sensitivity, specificity, positive predictive values, and negative predictive values for both modalities were calculated based on true positive and negative findings. The intra-observer area under curve (AUC) for detecting bone metastasis was compared by receiver operating characteristic analysis. Kappa coefficient calculated the inter-observer agreement. In conventional CT images, sensitivity, specificity, positive predictive value, and negative predictive value of raters 1 and 2 for the identification of bone metastases were 0.742 and 0.710, 0.981 and 0.981, 0.958 and 0.957, and 0.864 and 0.850, respectively. In water-HAP, they were 1.00 and 1.00, 0.981 and 1.00, 0.969 and 1.00, and 1.00 and 1.00, respectively. In CT, AUCs were 0.861 and 0.845 in each observer. On water-HAP images, AUCs were 0.990 and 1.00. Kappa coefficient was 0.964 for CT and 0.976 for water-HAP images.

Conclusions

The combination of CT and water-HAP images significantly increased diagnostic accuracy for detecting bone metastasis. Water-HAP images on DECT may enable accurate initial staging, reduced radiation exposure, and cost.



Apex Spectral – Pancreas TU w Liver and Bone Metastasis + Thrombus portal Vein



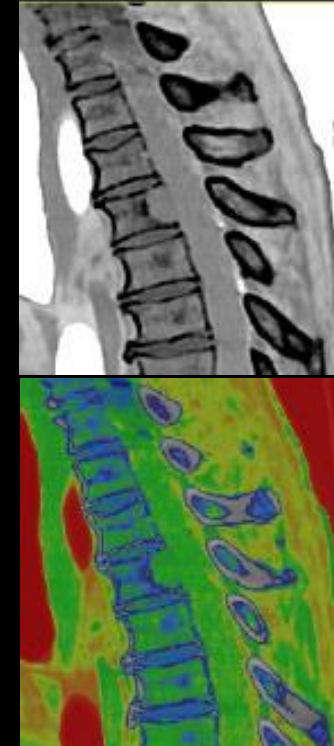
50 keV Mono 0.6mm



MD Ca (Iodine) 0.6mm



MD Iodine (CA) 0.6mm



MD Iodine (CA) 0.6mm

CT Revolution™ APEX TF

Image courtesy of Landeskrankenhaus Hall i. Tirol (Austria)

HCC POST TREATMENT

DEEP LEARNING IMAGE RECONSTRUCTION

HISTORY: HCC follow up post- treatment

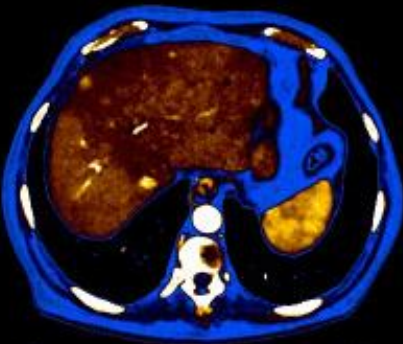
FINDINGS: New HCC and bone metastasis



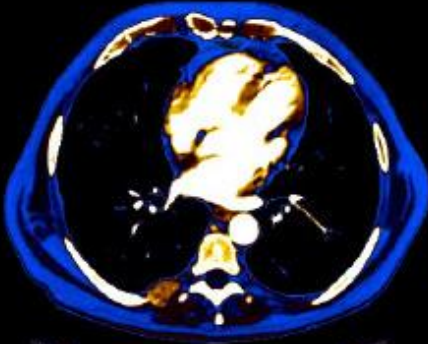
ARTERIAL 1.25 mm DLIR-M



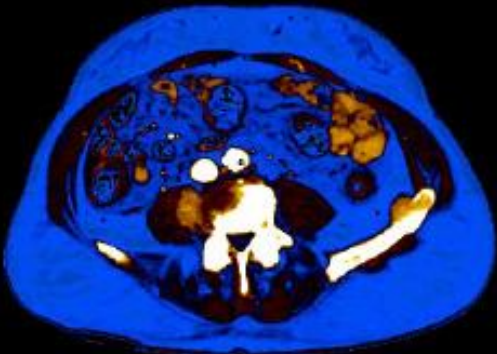
PORTAL 1.25 mm DLIR-M



ARTERIAL 1.25 mm DLIR-M
Iodine (water) + color map



ARTERIAL 1.25 mm DLIR-M
Iodine (water) + color map



PORTAL 1.25 mm DLIR-M
Iodine (water) + color map

CT Revolution™ APEX TF

CTDI 6,56 + 6,27 mGy

Spectral imaging clinical proof

Bone marrow edema

Bone marrow edema in non-traumatic hip: high accuracy of dual-energy CT with water-hydroxyapatite decomposition imaging

Wookon Son¹, Chankue Park², Hee Seok Jeong¹, You Seon Song³, In Sook Lee³

Affiliations expand | PMID: 31822976 DOI: 10.1007/s00330-019-06519-8

Abstract

Objective: To evaluate the diagnostic performance of dual-energy CT with water-hydroxyapatite (HAP) imaging for bone marrow edema in patients with non-traumatic hip pain.

Methods: Forty patients (mean age, 58 years; 16 male and 24 female) who underwent rapid kVp-switching dual-energy CT and MRI within 1 month between April 2018 and February 2019 with hip pain but no trauma were enrolled. Two radiologists retrospectively evaluated 80 hip joints for the presence, extent (femoral head involved, head and neck, and head to intertrochanter), and severity (mild edema, moderate, severe) of bone marrow edema on dual-energy water-HAP images. Water mass density (mg/cm³) on water-HAP images was determined with region of interest-based quantitative analysis. MRI served as the standard of reference.

Results: Sensitivity, specificity, and accuracy of readers 1 and 2 for the identification of bone marrow edema in water-HAP images were 85% and 85%, 93% and 73%, and 89% and 79%, respectively. The area under the receiver operating characteristic curve was 0.96 for reader 1 and 0.91 for reader 2 for differentiation of the presence of edema from no edema. The optimal water mass density to classify the presence of edema for reader 1 was 951 mg/cm³ with 93% sensitivity and 93% specificity and for reader 2 was 957 mg/cm³ with 80% sensitivity and 80% specificity. The more severe the edema, the higher was the mean water density value ($p < 0.035$).

Conclusions

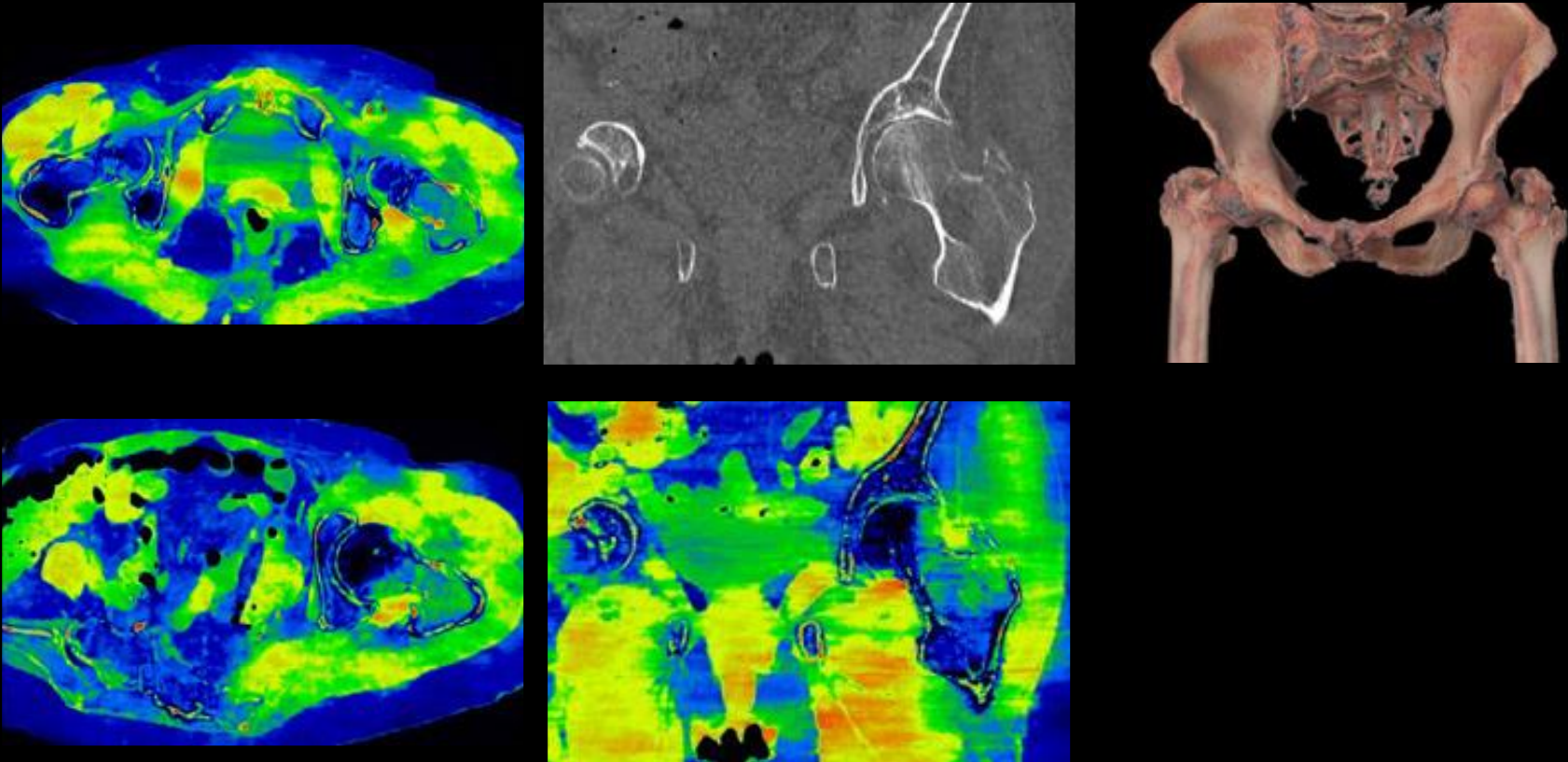
Dual-energy water-HAP images showed good diagnostic performance for bone marrow edema in patients with non-traumatic hip pain.



Know more

Bone Marrow Oedema – Hip

History	Fractured Hip
Findings	Fracture / Bone Oedema
	Colour Ramp Rainbow

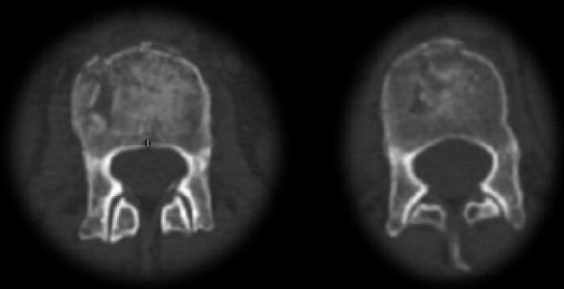


Images courtesy of Rigshospitalet Glostrup

CTDI 6,4 mGy

Bone Marrow Oedema – Hip

History	47-Year-old patient who felt
Findings	Edema in L2 and L1 with fracture. Maps show a clear increase in water signal and fat loss

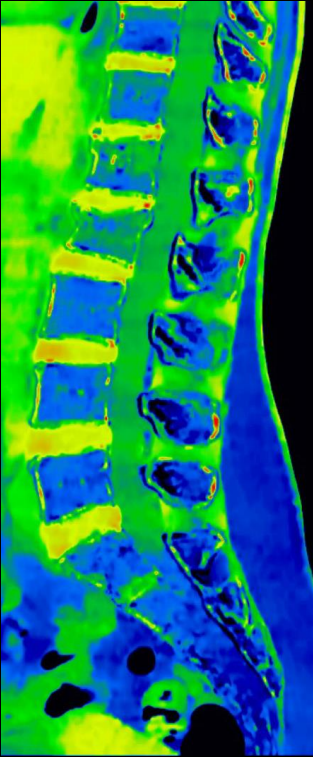


L2

L1



120 KvP



WATER (HAP)



FAT (WATER)



MRI

Image courtesy of Hospital Universitario de Cruces Spain

CTDIvol, mGy 6,3

Spectral imaging clinical proof

Dual-energy CT

Dual-energy CT in the diagnosis of occult acute scaphoid injury: a direct comparison with MRI

Cheng Xie¹, Sarim Ather², Ramy Mansour³, Fergus Gleeson⁴, Rajat Chowdhury³

Affiliations expand | PMID: 33341908 PMCID: PMC8128856 DOI: 10.1007/s00330-020-07604-z

Abstract

Objective: Scaphoid injuries occult on plain radiography often require further imaging for definitive diagnosis. We investigate the utility of dual-energy computed tomography (DECT) for the detection of acute bone marrow oedema and fracture of scaphoid compared to MRI.

Materials and methods: Twenty patients who presented acutely (without prior injury) to the emergency department with clinically suspected occult scaphoid fracture and had MRI of the wrist were prospectively recruited to have DECT (GE Revolution CT). Material decomposition images of the water-calcium base pair were generated and assessed in conjunction with the monochromatic images to permit correlation of marrow signal changes with any cortical disruption for fracture confirmation. The assessment was performed by two musculoskeletal radiologists blinded from MRI results. The statistical difference of MRI and reviewers' detection of acute bone oedema (1 = present, 0 = absent) was performed using the Friedman test (SPSS v.16).

Results: MRI showed acute scaphoid fracture and/or bone marrow oedema in 14/20 patients of which 6 also had cortical disruption. On DECT, reviewer A identified oedema in 13 and cortical disruption in 10 patients while reviewer B identified oedema in 10 and cortical disruption in seven of the 14 MRI positive patients. No statistically significant difference in oedema detection on MRI and reviewers of DECT (p value 0.61) but DECT was more sensitive at detecting cortical disruption.

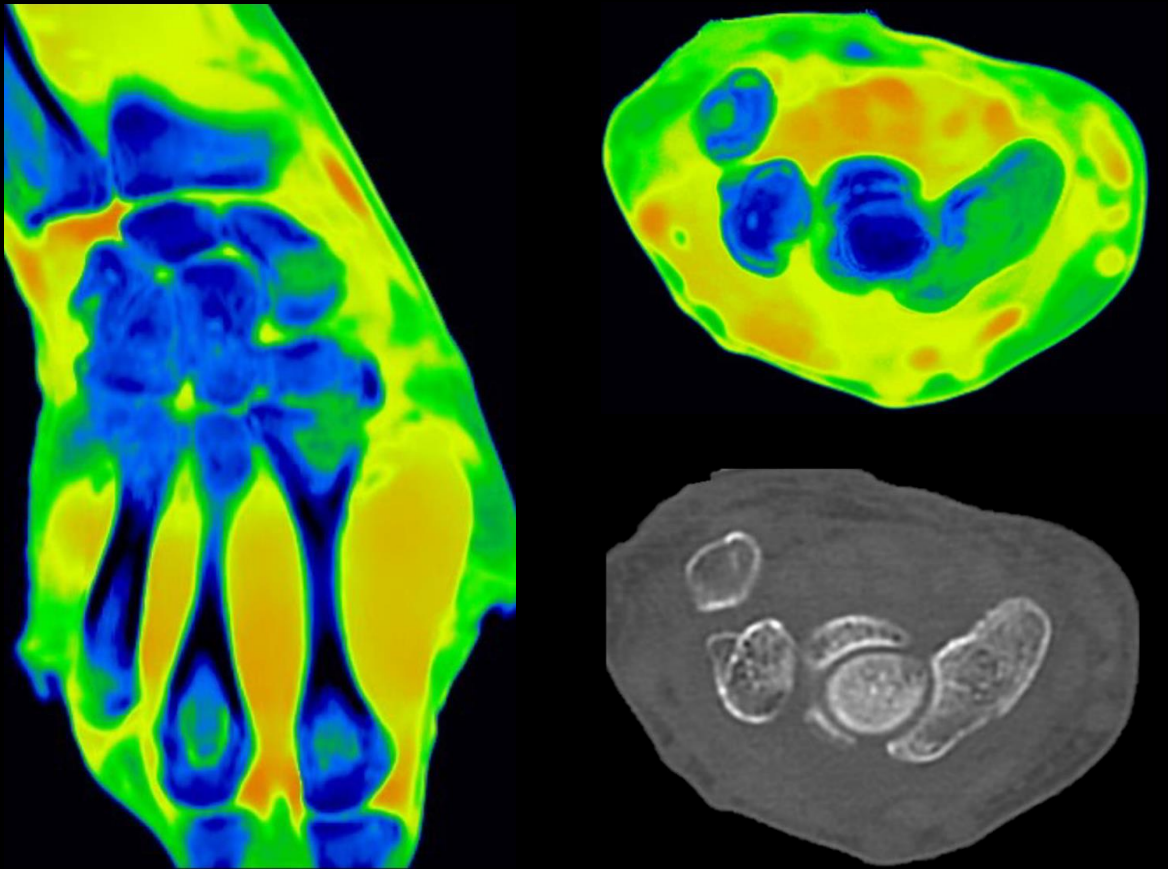
Conclusions

DECT has the capability to detect acute scaphoid oedema in addition to cortical fractures. However, compared to MRI, DECT has lower contrast resolution and less sensitive in the detection of mild oedema.



Bone marrow oedema - Wrist

History	Painful wrist
Findings	Bone Marrow Odema Fracture scaphoid



WATER (HAP)

Apex TrueFidelity for Spectral images

Images courtesy of Universitair Ziekenhuis Brussel, Belgium

Spectral imaging clinical proof

Gout

Dual energy CT findings in gout with rapid kilovoltage-switching source with gemstone scintillator detector

Elin Svensson¹, Ylva Aurell¹, Lennart T. H. Jacobsson², Anton Landgren², Valgerdur Sigurdardottir^{2,3} and Mats Dehlin^{corresponding author}²

Affiliations expand | PMID: 31989100 PMCID:PMC 6966802 DOI: 10.1186/s41927-019-010-5

Abstract

Background: A definite diagnosis of gout requires demonstration of monosodium urate crystals in synovial fluid or in tophi, which in clinical practice today seldom is done. Dual energy CT (DECT) has repeatedly been shown to be able to detect monosodium urate crystals in tissues, hence being an alternative method to synovial fluid microscopy. The vast majority of these studies were performed with CT scanners with two X-ray tubes. In the present study we aim to investigate if and at what locations DECT with rapid kilovoltage-switching source with gemstone scintillator detector (GSI) can identify MSU crystals in patients with clinically diagnosed gout. We also performed a reliability study between two independent readings.

Methods: Patients with new or established gout who had been examined with DECT GSI scanning of the feet at Sahlgrenska University Hospital, Mölndal between 2015 and 2018 were identified. Their medical records were sought for gout disease characteristics using a structured protocol. Urate deposits in MTP1, MTP 2–5, ankle/midfoot joints and tendons were scored semiquantitatively in both feet and presence of artifacts in nail and skin as well as beam hardening and noise were recorded. Two radiologists performed two combined readings and scoring of the images, thus consensus was reached over the scoring at each occasion (Espeland et al., BMC Med Imaging. 2013;13:4). The two readings were compared with kappa statistics.

Results: DECT GSI could identify urate deposits in the feet of all 55 participants with gout. Deposits were identified in the MTP-joints of all subjects but were also present in ankle/midfoot joints and tendons in 96 and 75% respectively. Deposition of urate was predicted by longer disease duration (Spearman's Rho 0.64, $p < .0001$) and presence of tophi ($p = 0.0005$). Artifacts were common and mostly found in the nails (73%), a minority displayed skin artifacts (31%) while beam hardening and noise was rare. The agreement between the two readings was good ($K = 0.66$, 95% CI = 0.61–0.71).

Conclusions

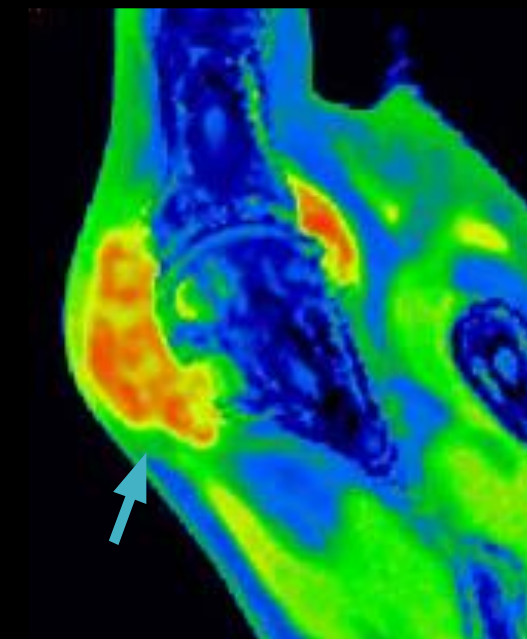
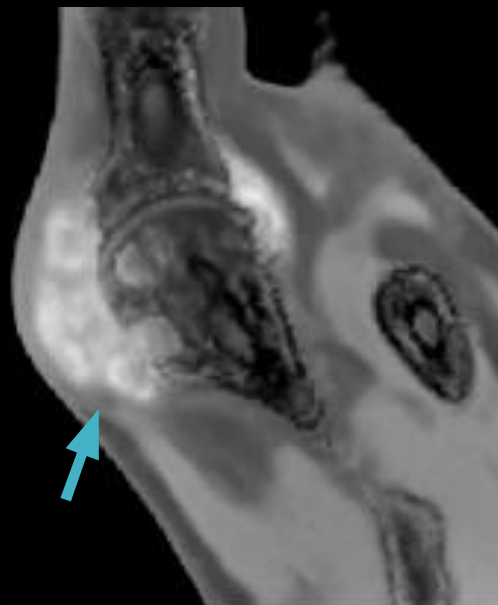
The validity of DECT GSI in gout is supported by the identification of urate in all patients with clinical gout and the good correlations with clinical characteristics. The occurrence of artifacts was relatively low with expected locations.



1-Click-Gout Analysis w Spectral Viewer 3D



MD HAP (Uric Acid)



MD Uric Acid (HAP)

CT Revolution™ APEX

Image courtesy of LH Hall i. Tirol (Austria), Dr. Michael Rieger

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