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CT Image Quality Evaluation of a New Iterative Reconstruction Algorithm in the Abdomen (ASIR-V) with comparison to MBIR, ASIR and FBP Reconstructions

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Abstract

Objective—The purpose of this study was to compare abdominopelvic CT images reconstructed with ASIR-V to model-based iterative reconstruction (Veo 3.0), ASIR, and filtered back projection (FBP).

Methods and Materials—Abdominopelvic CT scans for 36 patients (26 males and 10 females) were reconstructed using FBP, ASIR (80%), Veo 3.0 and ASIR-V (30, 60, 90%). Mean patient age and SD was 32 ± 10 years with mean BMI 26.9 ± 4.4 kg/m². Images were reviewed by two independent readers in a blinded, randomized fashion. Hounsfield unit, noise, and contrast-to-noise ratio (CNR) values were calculated for each reconstruction algorithm for further comparison. Phantom evaluation of low contrast detectability (LCD) and high contrast resolution was performed.

Results—ASIR-V 30%, ASIR-V 60% and ASIR 80% were generally superior qualitatively compared to ASIR-V 90%, Veo 3.0 and FBP ($P < 0.05$). ASIR-V 90% showed superior LCD and had the highest CNR in the liver, aorta, and pancreas, measuring 7.32 ± 3.22 , 11.60 ± 4.25 , and 4.60 ± 2.31 , respectively, compared to the next best series of ASIR-V 60% with respective CNR values of 5.54 ± 2.39 , 8.78 ± 3.15 , and 3.49 ± 1.77 ($P < 0.0001$). Veo 3.0 and ASIR 80% had the best and worst spatial resolution, respectively.

Conclusion—ASIR-V 30% and ASIR-V 60% provided the best combination of qualitative and quantitative performance. ASIR 80% was equivalent qualitatively, but demonstrated inferior spatial resolution and LCD.

Keywords

Iterative reconstruction; ASIR; MBIR; CT Image Quality; Abdomen

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Introduction

Filtered back projection (FBP) has long been the mainstay of image reconstruction in computed tomography (CT). Due to the notable increased use of CT in the past several years, there is an ongoing effort to reduce radiation dose from CT scans while maintaining image quality. Unfortunately, the use of FBP alone as a primary reconstruction algorithm is constrained in this setting due to prominent noise and artifacts that occur as CT radiation doses are lowered.¹

Limited performance of FBP at lower radiation doses and improved computational power have allowed iterative reconstruction (IR) use to improve or maintain image quality. IR methods function through an iterative process of approximation to an expected image using known CT system characteristics. IR algorithms can provide significant image noise and artifact reduction to preserve image quality,^{2,3} which can be particularly useful when scanning large patients, implementing low radiation dose protocols or performing small field-of-view scans such as cardiac CT.⁴

One of the first clinically available IR techniques, and one of the most extensively studied, is Adaptive Statistical Iterative Reconstruction (ASIR) (GE Healthcare, Waukesha, WI). ASIR attempts to remove noise which is likely due to statistical fluctuations.^{1,5} This produces a change in noise texture relative to FBP which has been of concern.⁵ Importantly, the desired balance between noise reduction and image texture alteration needed for a given clinical application can be obtained through choosing the percentages of blending of iterative reconstruction with FBP.

Model-based iterative reconstruction (MBIR) is a more comprehensive version of IR, which uses both back and forward projections. Complex system modeling is used iteratively between the projection data space and image data space using a computationally intensive and relatively time consuming process. Veo (GE Healthcare, Waukesha, WI) is a vendor-specific implementation of MBIR, which is commercially available. Images produced by Veo are not blended with FBP, which allows for aggressive noise reduction beyond that of FBP or ASIR.⁶ MBIR images have been criticized for their image texture^{7,8} and the time required to perform such reconstructions.⁹

Adaptive Statistical Iterative Reconstruction – V (ASIR-V) (GE Healthcare, Waukesha, WI) is the latest version of a vendor-specific iterative reconstruction from GE. ASIR-V is a hybrid between the technologies of ASIR and Veo. Importantly, compared to Veo, ASIR-V uses a less complex system model for forward projection which de-emphasizes the system optics, resulting in faster reconstruction times.¹⁰ ASIR-V uses more advanced noise, object and physics modeling than ASIR. ASIR-V has been shown to reduce noise and improve image quality when compared to FBP in ultra-low dose cardiac CTA.⁹ Studies have also shown improved contrast-to-noise ratio and spatial resolution in phantom analysis compared to FBP and ASIR.¹¹ Kwon et al. demonstrated the potential for an additional radiation dose reduction of 35% in the abdomen with ASIR-V when compared to ASIR.¹²

The purpose of this study was to compare abdominopelvic CT images reconstructed with ASIR-V to MBIR (Veo 3.0), ASIR, and FBP, including both qualitative and quantitative performance. The appearance of lesions was also compared qualitatively and quantitatively between reconstructions.

Materials and Methods

This retrospective study was approved by our institutional review board as Health Insurance Portability and Accountability Act compliant, and the need for informed consent was waived.

Patient Selection and Characteristics

Based on a power analysis, we acquired imaging data from 36 patients, who underwent routine abdominal or abdominopelvic CT scanning between April 2015 and March 2016, and had raw imaging data saved. Each patients' age, sex, primary cancer diagnosis, height, weight and body mass index were recorded. The studied group consisted of 26 males and 10 females with a mean age and SD of 32 ± 10 years (Range, 20 years - 58 years), an average patient weight of 79.5 ± 16.1 kg (Range, 46.3 kg -127.3 kg) and mean BMI 26.9 ± 4.4 kg/m² (Range, 17.0 - 39.8). The most common diagnosis was testicular cancer in 17 patients followed by non-Hodgkin lymphoma in 9 patients and Hodgkin lymphoma in 7 patients. There was one patient each with Castleman disease, mediastinal germ cell tumor, and lymphadenopathy without known cancer.

Radiation Dose Estimation

The effective diameter of each patient was obtained based on the anterior-posterior (AP) and lateral (LAT) scout measurements (effective diameter = $(AP+LAT)^{1/2}$). The volume CT dose index (CTDIvol) for a 32-cm phantom was obtained. Size-specific dose estimates were calculated as recommended by the American Association of Physicists in Medicine Report No. 204 (Table 1).^{13,14}

Imaging Technique and Post-processing

All patients underwent CT of the abdomen using the same imaging protocol performed on Discovery CT750 HD scanners (GE Healthcare) with the following parameters: gantry speed of 0.6 seconds, pitch of 0.984:1, table speed of 39.375 mm/rotation, beam collimation of 40 mm with detector configuration of 64×0.625 mm, 120 kVp and tube current modulation using a noise index adjusted for patient circumference. One hundred milliliters of Iohexol 350 mg I/mL (Omnipaque® 350, GE Healthcare) was injected at 2.5 to 3 mL/sec with bolus tracking using a 100- Hounsfield unit (HU) trigger value in the abdominal aorta at the level of the celiac artery and a scan delay of 45 seconds. Twenty-four of the patients also had simultaneous imaging of the pelvis obtained using the same settings as in the abdomen, except for the noise index setting which was relatively higher than in the abdomen and was based on the pelvic width.

Six axial reconstructions were performed for each patient to a 3.75mm slice thickness: FBP (standard algorithm), 80% ASIR, Veo 3.0 (Noise Reduction 5%), and ASIR-V with three

different levels of blending with FBP:30%, 60%, and 90% (hereafter, ASIR-V 30, ASIR-V 60, and ASIR-V 90, respectively).

Qualitative Analysis

The images from all patients were reviewed by two of the authors who were not readers (M.H.G. and C.T.J.) and all lesions were flagged as key images. Lesions were defined as any non-calcified, focal, solid organ abnormality larger than 2 mm of either increased or decreased relative attenuation.⁷ As many of the patients had the diagnosis of lymphoma, lymphadenopathy was also counted as a lesion. If there were multiple lesions of the same type (e.g., liver cysts or enlarged lymph nodes), a single representative lesion was chosen and flagged. The type of lesion present on the flagged images was recorded.

All six reconstructions for each patient were displayed on a two monitor picture archiving and communications system. The hanging order of the reconstructions and the order of patient review were randomized. All identifying information and annotations were removed. The view ports were linked so that identical slice levels could be evaluated on all reconstructions while scrolling through the image stacks. The images were initially presented with a window/level setting of 500/50, and the readers were allowed to scroll through the cases, change the window level settings and zoom and pan while reviewing the cases.

Two blinded readers independently reviewed each case during three reading sessions after receiving standardized instructions and reviewing an orientation case which was not part of the final data set. A written copy of the instructions was provided during the reading sessions for reference. Both readers were fellowship trained and had 7 years (N.W.-B.) and 5 years (S.G.) of additional experience reading abdominal CT since fellowship. There was no time limit for review.

A comparative scale was used to rank the overall image quality in the abdomen for each reconstruction. A score of 0 was given for the best series, -1 for slightly inferior (no influence on diagnosis), -2 for mildly inferior (possible influence on diagnosis), -3 for moderately inferior (probable influence on diagnosis), and -4 for markedly inferior (impairing diagnosis). Scores could be used more than once if reconstructions were judged to be equivalent.

The same comparative scale was then used for evaluation of the small structures (such as the adrenal glands, lymph nodes and vessels), the liver (contour and parenchyma), bones, and, if imaged, the overall quality in the pelvis. The readers were then directed to evaluate the appearance any lesions present on the marked key images using the same comparative scale. Readers were asked to focus on perceived lesion contrast and sharpness.¹⁵

Quantitative Analysis

Three-dimensional spherical regions of interest (ROIs) were drawn on each reconstruction using GE Advantage Workstation software 3.2 (GE Healthcare). The reconstructions were linked in each viewport so that identical ROIs could be drawn in the same location on each reconstruction. Three ROIs were drawn in the liver, three in the pancreas, one within the

aorta, one on each side of the paraspinal musculature, and four in the subcutaneous abdominal fat (one within each of the anterior and posterior quadrants). Care was taken to avoid confounding structures such as large vessels, lesions, and atheromatous plaques in each ROI. Additionally, spherical ROIs were drawn within all lesions with a long axis greater than 1 cm identified during the qualitative analysis. The HU and SD within each lesion were recorded. The ROI sizes varied slightly from patient to patient due to differences in anatomy.¹⁵

For each reconstruction, the contrast-to-noise ratio (CNR) relative to muscle was calculated for the aorta and liver as $(ROI_i - ROI_m)/SD$, where ROI_i is the mean HU for the anatomy of interest, ROI_m is the mean HU of paraspinal muscles, and SD is the mean image noise based on subcutaneous fat, using the average standard deviation in HU.¹⁶

A Catphan 600 phantom (The Phantom Laboratory, Inc, Salem, NY) was used to quantitatively evaluate the low contrast detectability (LCD) and high contrast spatial resolution of the different reconstruction methods. The specific testing modules were surrounded by an oval-shaped, fat-equivalent ring to mimic the size and shape of the abdomen (Fig. 1).

The water-equivalent uniform module, CTP 486, was scanned at different dose levels by varying the tube current from 120 mA to 600 mA at increments of 60 mA. The key scan parameters were: 120 kVp, 0.6 s rotation time, 40 mm beam collimation, “LargeBody” scan field of view, and 0.984:1 pitch factor. Images were reconstructed to a 5 mm slice thickness and a display field of view of 227 mm for each reconstruction algorithm. The image sets were then evaluated using the GE built-in LCD performance tool run at the scanner console to assess the LCD and image noise. The tool is one of the image analysis tools available under the image quality tab in the service desktop of modern GE CT scanners, and uses a statistical method to compute an LCD value and standard deviation of a given uniform CT image. The output of the tool gives the contrast in HU necessary to detect a lesion of a user-defined diameter with 95% confidence. Because the output is contrast, a smaller number corresponds to better performance. A central slice within the uniform water section of the phantom with a lesion diameter of 3 mm was selected for measuring the LCD and the results were averaged over 8 images at each dose level.

The high contrast spatial resolution was evaluated by comparing the line profile across the 7 lp/cm bar pattern of the CTP528 high contrast module. The module was scanned at 70 mAs and the other scanner settings were the same as for the LCD portion of the examination. The images were reconstructed to 2.5 mm slice thickness with each reconstruction algorithm. The high contrast image sets were then analyzed on a desktop computer with line profiles drawn across the 7 lp/cm bar pattern (Fig. 2) using Matlab software (The MathWorks, Inc, Natick, MA). Larger magnitude (peak-to-peak) of bar pattern line profile corresponds to better spatial resolution.

Statistical Analysis

Summary statistics for image quality scores, CNR, lesion HU and lesion SD were calculated as means, standard deviations, and ranges for each item and series. A linear mixed model

was used to estimate and compare scores and rankings between series by item, with patients, or lesions, and readers modeled as a random effect for the quality scores. The mixed model takes into account correlations between scores and rankings from the same patient, or lesion, and reader. Tukey-Kramer adjustment was used for pairwise comparisons between series to control the overall type I error rate at 5%. All tests were 2-sided, and P values of 0.05 or less were considered statistically significant. Statistical analysis was performed by a biostatistician using SAS version 9 (SAS Institute, Cary, NC).

Results

Radiation Dose

The average effective abdominal diameter was 30.9 ± 3.7 cm (Range, 23.6 cm - 42.2 cm). Mean CTDI_{vol} in the abdomen was 6.8 ± 3.8 mGy (range, 4.4 - 11.8 mGy) and mean SSDE in the abdomen was 7.9 ± 3.2 mGy (range, 4.8 - 11.7 mGy).

Lesions

74 lesions were found, and all but one patient had at least one lesion. Of these lesions, 45 were larger than 1 cm and were amenable to measurement of HU and SD: 23 nodal disease, 8 liver cysts, 5 renal cysts, 3 ovarian dermoids, and 6 were listed as other (e.g., splenic cyst).

Qualitative Image Assessment

On the 5-point Likert scale for overall abdomen image quality, evaluation of small structures, evaluation of the liver, and overall quality in the pelvis, the readers rated ASIR-V 30 as best, followed by either ASIR-V 60 or ASIR 80 depending on the area evaluated. The differences in the ratings of these three reconstructions were not statistically significant. These three reconstructions did have statistically significantly higher ratings in all areas when compared to ASIR-V 90 and FBP. FBP had a significantly lower rating in all areas compared to the other reconstructions with the exception of bone evaluation. Similarly, for lesion evaluation, ASIR-V 30 was the most highly rated and ASIR-V 30, ASIR-V 60, and ASIR 80 had statistically significantly higher ratings when compared to Veo 3.0, ASIR-V 90 or FBP (Fig. 3).

Specific comments noted and recorded during the reading sessions about individual reconstructions included relative dislike of the Veo 3.0 texture as has been described previously. The ASIR-V 90 series was also often described as having an overly-smoothed appearance. As would be expected, comments about images created with FBP reconstruction centered on the relatively prominent noise compared to the other reconstructions (Fig. 4).

Quantitative Image Assessment

ASIR-V 90 produced the highest CNR in the liver, pancreas, and aorta ($P < 0.0001$), followed by ASIR-V 60, ASIR 80, Veo 3.0, ASIR-V 30, and FBP. Each reconstruction had a significantly different CNR from the next best reconstruction except between ASIR 80 and Veo 3.0 ($P > 0.99$) in all regions and between ASIR-V 60 and ASIR 80 in the pancreas ($P = 0.17$) (Table 1).

The HU values measured within lesions did not differ significantly between reconstructions. As expected, the noise values (measured as standard deviation of Hounsfield unit measurement) recorded within lesions were highest on FBP reconstructions, followed by ASIR-V 30, ASIR-80, Veo 3.0, ASIR-V 60 and ASIR-V 90. Noise measured within lesions on ASIR 80 was not significantly different than Veo 3.0 ($P = 0.057$) and lesion noise measured in Veo 3.0 was not significantly different than ASIR-V 60 ($P = 0.74$). All other reconstructions showed significantly different noise levels within lesions.

ASIR-V 90 demonstrated superior low contrast detectability during phantom analysis at all radiation dose levels followed by ASIR-V 60, Veo 3.0, ASIR-V 30, ASIR 80, and FBP. ASIR-V 60 performed slightly better than Veo 3.0 at all doses except the lowest dose level of approximately 5 mGy, where Veo 3.0 performed slightly better than ASIR-V 60. ASIR-V 30 and ASIR 80 also performed similarly at doses higher than 15 mGy, while ASIR-V 30 performed slightly better than ASIR 80 at doses lower than 15 mGy. FBP had the worst LCD performance among all reconstruction methods. As expected, the differences in LCD were greatest at low doses (Fig. 5). Veo 3.0 had the best spatial resolution when evaluated with the high contrast phantom. The other reconstructions had similar high contrast resolution performance with ASIR 80 demonstrating the lowest spatial resolution (Fig. 6).

Discussion

Our study evaluated ASIR-V, which is a hybrid IR method between ASIR and Veo. To our knowledge, this is the first study to evaluate lesions in the abdomen with ASIR-V and, importantly, to compare the qualitative and quantitative performance of ASIR-V to Veo 3.0; comparisons were also made to ASIR and FBP.

ASIR-V 30, ASIR-V 60 and ASIR 80 were qualitatively superior when compared to ASIR-V 90 and FBP. ASIR-V 30, ASIR-V 60 and ASIR 80 also had a statistically significant higher rating than Veo 3.0 in the overall abdomen evaluation, lesion evaluation, and in the evaluation of small structures. This is despite the quantitatively better performance of ASIR-V 90 in low contrast detectability and CNR and despite the better high-contrast spatial resolution of Veo 3.0.

The discrepancy between the qualitative evaluation and quantitative performance is likely a function of underlying image textural changes which are most notable with Veo 3.0 and ASIR-V 90 images, as was commented on during the reading sessions and has been described in previous studies.^{7,8,17} Increased levels of FBP blended with ASIR-V produced superior qualitative scores despite these reconstructions of ASIR-V 30 and ASIR-V 60 generally performing in the middle of the spectrum on quantitative measurements. ASIR 80, while not statistically different qualitatively from ASIR-V 30 and ASIR-V 60 reconstructions, demonstrated the worst spatial resolution and second worst LCD. These findings suggest that, depending on reader preferences and clinical use, ASIR-V 30 or ASIR-V 60 provided the best balance between producing clinically acceptable images and quantitative imaging performance with the exception of bone evaluation which was superior with FBP.

Previous studies have shown that iterative reconstruction techniques effectively reduce image noise and artifacts, preserving image quality in the context of radiation dose reduction.^{18,19} While MBIR (Veo 3.0) offers a more complex and robust noise reduction method than ASIR, the significant time required for image reconstructions remains an important consideration for clinical operations. ASIR-V reduces computational demands compared to Veo while utilizing enhanced system modeling compared to ASIR.¹⁰ Our study shows the robust noise reduction potential of ASIR-V, the degree of which must be chosen based on the clinical task which can guide the proper balance of CNR, LCD and spatial resolution.

This study has several limitations. First, the clinical images were only evaluated at a single radiation dose per patient. Since the relative advantages of iterative reconstructions are greatest at lower radiation doses, the qualitative evaluation of the images would likely change if we assessed various dose levels, as is supported based on our quantitative LCD results. Second, our radiation dose reduction efforts were necessarily modest due to the high pretest probability of lesions, often small, in this oncologic population. Third, we only evaluated a single Veo 3.0 reconstruction setting; we would note, this reconstruction setting was chosen based on prior empiric work demonstrating the noise reduction 5% preset to be superior in contrast-enhanced abdominal imaging for our population. Finally, this study is inherently vendor-specific.

In summary, the new vendor-specific method of iterative reconstruction, ASIR-V, was evaluated and compared to MBIR (Veo 3.0), ASIR 80%, and FBP. ASIR-V 30% and ASIR-V 60% produced the best balance between qualitative and quantitative performance, including lesion evaluation. The choice of the ideal ASIR-V reconstruction blend with FBP must be determined while keeping in mind the intended clinical task, radiation dose and reader preferences. Further evaluation of ASIR-V is necessary to assess task-specific accuracy and thresholds for proper blending with FBP at specific dose levels.

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Figure 1. Phantom evaluation was performed using a Catphan 600 phantom with different modules surrounded by an oval shaped, fat-equivalent ring to mimic the size and shape of the abdomen.

Figure 2.
High contrast resolution was determined by drawing a line profile across the 7 lp/cm bar pattern.

Figure 3.

Qualitative image evaluation showed a statistically significant reader preference for ASIR-V 30, ASIR-V 60 and ASIR 80. A score of 0 was given for the best series, -1 for slightly inferior (no influence on diagnosis), -2 for mildly inferior (possible influence on diagnosis), -3 for moderately inferior (probable influence on diagnosis), and -4 for markedly inferior (impairing diagnosis).

Figure 4.

Qualitative evaluation of the different reconstructions showed a preference for ASIR-V 30, ASIR-V 60 and ASIR 80 which were not significantly different from one another. A subtle area of focal fat deposition is shown here on the different reconstructions.

Figure 5.

Low contrast detectability in the phantom using the GE built-in LCD performance tool was best with ASIR-V 90. ASIR-V 60 and Veo 3.0 had very similar performance to one another as did ASIR 80 and ASIR-V 30. FBP had the worst LCD performance.

Figure 6.

High contrast resolution in the phantom was best with Veo 3.0. The other reconstructions had much more similar performance to one another with ASIR 80 demonstrating the worst spatial resolution.

TABLE 1

Attenuation, Noise and Contrast to Noise in the Abdomen. CNRs ranked from highest to lowest are ASIR-V 90, ASIR-V 60, ASIR 80, Veo 3.0, ASIR-V 30, and FBP.

Mean $\pm$ SD		FBP	ASIR 80	Veo 3.0	ASIR-V 30	ASIR-V 60	ASIR-V 90
Attenuation (HU) *							
Liver		127.54 $\pm$ 20.40	127.54 $\pm$ 20.41	127.63 $\pm$ 20.60	127.52 $\pm$ 20.42	127.52 $\pm$ 20.42	127.53 $\pm$ 20.43
Aorta		164.21 $\pm$ 30.55	164.11 $\pm$ 30.50	163.92 $\pm$ 31.19	164.09 $\pm$ 30.50	163.91 $\pm$ 30.46	163.84 $\pm$ 30.43
Pancreas		106.45 $\pm$ 19.60	106.36 $\pm$ 19.66	106.02 $\pm$ 19.76	106.18 $\pm$ 20.16	106.15 $\pm$ 20.20	106.07 $\pm$ 20.19
Paraspinal muscle		68.13 $\pm$ 6.58	68.15 $\pm$ 6.58	68.43 $\pm$ 5.69	68.19 $\pm$ 6.54	68.19 $\pm$ 6.55	68.19 $\pm$ 6.57
Subcutaneous fat		-107.47 $\pm$ 7.49	-107.37 $\pm$ 7.51	-107.61 $\pm$ 7.61	-107.36 $\pm$ 7.42	-107.31 $\pm$ 7.42	-107.27 $\pm$ 7.41
Noise (HU SD)							
Liver		23.90 $\pm$ 3.08	14.27 $\pm$ 1.94	12.56 $\pm$ 1.39	15.38 $\pm$ 1.79	11.99 $\pm$ 1.38	8.78 $\pm$ 1.06
Aorta		29.81 $\pm$ 4.45	16.69 $\pm$ 2.61	13.62 $\pm$ 1.77	18.30 $\pm$ 2.39	13.98 $\pm$ 1.94	9.76 $\pm$ 1.68
Pancreas		28.02 $\pm$ 3.39	16.35 $\pm$ 2.42	14.94 $\pm$ 2.26	18.65 $\pm$ 2.81	14.74 $\pm$ 2.76	11.03 $\pm$ 2.90
Paraspinal muscle		23.54 $\pm$ 3.84	13.55 $\pm$ 2.30	11.74 $\pm$ 1.40	15.25 $\pm$ 2.07	11.70 $\pm$ 1.58	8.32 $\pm$ 1.17
Subcutaneous fat		20.17 $\pm$ 3.02	12.46 $\pm$ 2.00	12.01 $\pm$ 1.48	14.03 $\pm$ 2.01	11.17 $\pm$ 1.78	8.53 $\pm$ 1.64
CNR [†]							
Liver		3.10 $\pm$ 1.44	5.04 $\pm$ 2.39	5.02 $\pm$ 1.86	4.39 $\pm$ 1.88	5.54 $\pm$ 2.39	7.32 $\pm$ 3.22
Aorta		4.91 $\pm$ 1.87	7.98 $\pm$ 3.11	8.07 $\pm$ 2.72	6.98 $\pm$ 2.47	8.78 $\pm$ 3.15	11.60 $\pm$ 4.25
Pancreas		1.99 $\pm$ 1.06	3.22 $\pm$ 1.72	3.15 $\pm$ 1.44	2.78 $\pm$ 1.41	3.49 $\pm$ 1.77	4.60 $\pm$ 2.31

* No Significant difference in HU identified between reconstructions

[†] CNR was significantly different from the next best reconstruction except between ASIR 80 and Veo 3 (P > 0.99) in all regions and between ASIR-V 60 and ASIR 80 in the pancreas (P = 0.17)