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Original Article

Correlation Between Diffusion-Weighted MRI and Metabolic PET/CT Parameters in Patients with Pancreatic Cancer

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Abstract

Background: Pancreatic cancer's morbidity and mortality rates have been rising annually in recent years. Assessment of morphology and metabolic activity of pancreatic lesions using maximum standardized uptake value [SUV_{max}] has been made possible by the rapid progress of positron emission tomography/computed tomography [PET/CT].

Aim of the work: This study aimed to evaluate the correlation between the mean ADC value of diffusion weighted MRI and SUV_{max} of 18F-FDG PET/CT in pancreatic cancer.

Patients and methods: The study included 30 individuals with histologically confirmed pancreatic adenocarcinoma. MRI DWI and 18F-FDG PET/CT were performed on each subject. ROI was applied over the pancreatic lesion to get the SUV_{max} and ADC_{mean} values. Then the agreement between two values was studied. Additionally, we examined the efficacy of employing SUV_{max} > liver uptake as a diagnostic tool and assessed how DWMRI and PET/CT characteristics work together to improve diagnosis.

Results: When the ADC value is less than $1.3x10^{-3}$, pancreatic cancer can be diagnosed with 83.33% sensitivity and 83.33% accuracy. Pancreatic lesions with SUV_{max} > liver activity can diagnose pancreatic cancer with 90% Sensitivity and 90% Accuracy. Combination of DW MRI and PET/CT parameters improved pancreatic cancer detection with 93.33% Sensitivity and 93.33% Accuracy. There was a moderate agreement between ADC_{mean} and SUV_{max} in diagnosis of pancreatic cancer [kappa =0.429]. ADC pancreatic lesion/normal pancreatic parenchyma ratio can diagnose pancreatic cancer at cut off ≤0.69 [AUC =0.856] with 88.00 % sensitivity, 80.00% Specificity, 95.7% PPV and 57.1% NPV. There was a negative correlation between ADC_{mean} and SUV_{max} of the pancreatic lesions [r=-0.491, P =0.005].

Conclusion: ADC values negatively correlated with SUV_{max} in pancreatic cancer. SUV_{max} and ADC values can diagnose pancreatic cancer with 90% and 83.33% accuracy receptively. Higher sensitivity and accuracy [93.33%] of combined DWMRI and18F-FDG PET/CT reinforce the complementary value of both methods in tumor assessment.

Keywords: Agreement; Correlation; 18FDG PET/CT-DW-MRI; Pancreatic cancer; SUV_{max}.

INTRODUCTION

According to predictions, pancreatic cancer is expected to rise above colorectal cancer by 2030, making it the second most deadly type of cancer in terms of its major impact on cancer-related death, after lung cancer. Now, the most common therapeutic approaches for treating pancreatic cancer are surgery and chemotherapy [1].

Metabolic activity in various kinds of tissues and tumours can be assessed using 2-deoxy-2-fluoro-D-glucose–positron emission tomography/computed tomography [FDG-PET/CT] [2].

PET/CT is widely recognised as a valuable test for tumour staging and therapy monitoring in pancreatic cancer, and most malignant tumours exhibit enhanced FDG uptake, and a high standardised uptake value [SUV max] related to an increased rate of glycolysis and glucose transport [3].

By using 18-Fluorodeoxy-Glucose Positron Emission Tomography-Computerized Tomography [18FDG PET/CT], physicians can see tumour tissues directly and in high resolution, which have higher levels of FDG absorption and glucose utilisation than normal cells. By measuring the uptake of FDG in tumour tissues, it is now a non-invasive functional approach that can assess glucose metabolism at the molecular level. This non-invasive method is becoming increasingly crucial for diagnosis, early identification, response to treatment assessment, and prognostic prediction [4].

Changes in intracellular and extracellular water mobility are detected by DW-MRI [5, 6].

The DW signal is increased in tumours with a high cell density than in signals resulting from inflammatory processes. [5].

Tissue-specific characteristics, such as the apparent diffusion coefficient [ADC, [mm^2/s]], can be computed for quantification. When tumours show a low ADC on initial imaging, DW-MRI could be a useful diagnostic technique [7].

The Aim of the work

The aim of this work was to evaluate the correlation between the mean ADC value of diffusion weighted MRI and SUV max of 18F-FDG PET/CT and to assess the diagnostic importance and added value of SUV max and ADC mean in pancreatic cancer patients.

PATIENTS AND METHODS

In this study, 181 patients were assessed for eligibility, sixty-nine patients were excluded because of refusal of invasive biopsy procedure. Thirty-one patients were excluded also because they had claustrophobia.

Twenty-five patients had uncontrolled diabetes and refused PET-CT study. Eleven patients were missing during the study. Fifteen patients refused to join the study. The remaining 30 patients were histologically confirmed to have pancreatic adenocarcinoma. MRI DWI and 18F-FDG PET/CT were performed on each subject. All patients [30] followed up and analyzed statistically.

This prospective study comprised 30 pancreatic cancer patients who attended the National Liver Institute Hospitals' diagnostic medical imaging and interventional radiology department at Menoufia University between October 2020 and October 2024.

We included patients with histologically confirmed pancreatic cancer [after a true cut or fine needle biopsy/aspiration]. However, we excluded from the study critically ill patients who can't withstand long time of PET CT& DW MRI examinations, patients with claustrophobia or MRI incompatible metallic prosthesis, children & pregnant women due to radiation hazards of 18F-FDG PET/CT, uncooperative patients with excessive motion and patients who refused the exam. Following a thorough explanation of the study's purpose, its producers, and an affirmation of their rights, all eligible patients completed an informed consent form. The National Liver Institute Ethics Committee [REC] and medical research also examined and approved the study protocol [N-00014014/ FWA00034015] [Menoufia University].

Every patient who was included underwent a history taking, demographic data collection [age, sex], clinical examination, laboratory testing [random blood sugar, renal function tests, serum urea, creatinine], tumor markers [Carbohydrate Antigen 19-9 [CA 19–9], and radiological testing, including 18 FDG-PET/CT and DW-MRI [Diffusion Weighted-Magnetic resonance Imaging].

MRI examination:

The patient fasted for four to six hours prior to the procedure. A surface coil was employed while the patient was lying supine on the examination table and headfirst on the MRI table. The iliac crest and the bases of the lungs were scanned. GE Healthcare, Milwaukee, WI, USA, used a clinical 1.5-Tesla MRI system to examine each patient.

DWI- MRI protocol:

A phased-array coil was used for pancreatic imaging. The following sequences were part of the standard imaging protocol: T2 weighted pulse sequences: Axial T2-weighted image and Diffusion weighted images, using single shot spin echo planar imaging [SS-EPI] in the axial plane with two diffusion sensitivity coefficient [b] values of 0 and 800 s/mm^2 was obtained.

ADC calculation:

A region of interest was drawn over the pancreatic lesion to determine the mean ADC value of the lesion. Two measurements of the ADC were performed, and the average of the two readings was calculated. Regions of interest were copied and pasted from DW images to ADC maps to ensure that the same areas were measured. We investigated the diagnostic validity of pancreatic cancer using the ADC cut-off value of 1.3, which is the higher cut-off value documented in the literature. For every lesion, the ratio of ADC pancreatic lesion to ADC normal pancreatic tissue was also evaluated.

18 F-FDG PET-CT:

Before patient arrival: 24 hours prior to the scan, a low-carb, high-protein diet was necessary. The patient was directed to fast for at least six hours before the scan. minimal exercise in 24 hours before the scan. both at home and when travelling to the institute,

wearing warm clothing. Only plain water was allowed because it was accepted prior to entering the institute.

On patient arrival: History was taken and physical examination of the patient was done; Intravenous line is inserted. Blood glucose levels were kept below 200 mg/dl prior to intravenous tracer administration. Fluorine-18 fluorodeoxyglucose [18 F-FDG] was the tracer that was applied, and its dosage was 0.1 mci/kg. Following the tracer injection, the patient was instructed to remain in a dark, warm blanket-covered room for 60 to 70 minutes without talking, chewing, or reading. After that time, the patient was advised to void and was led to the scanning room.

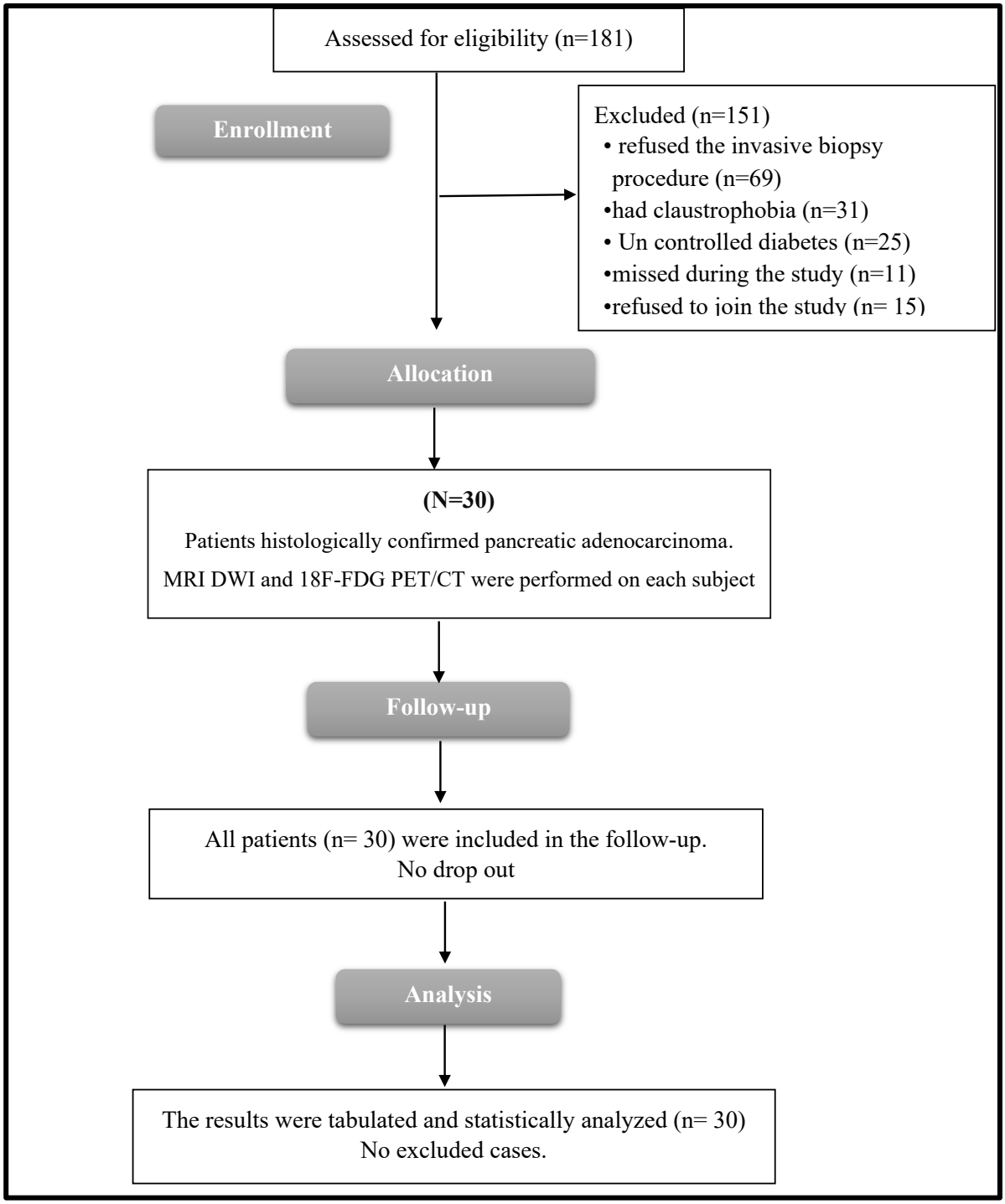

Figure [1]: CONSORT flowchart of the enrolled patients

18 F-FDG PET-CT scan protocol: 18 F-FDG Siemens [Biograph] PET/CT scanner with 128 MDCT tube was used to perform the PET-CT scan. Emission imaging at the same scan range in three-dimensional mode with three minutes per bed was performed right after a low-dose CT scan for attenuation correction from the base of the skull down to the upper thighs. For PET image reconstruction, iterative techniques [TrueX+TOF [time of flight] [ultraHD [high definition]-PET], 2 iterations, 21 subsets] were applied. Data were adjusted for scatter and filtered [FWHM [full

width at half maximum] 4.0 mm]. To prevent artifacts caused by motion, a limited breath-hold approach was employed.

Image analysis: The attenuation-corrected FDG-PET and CT images for every patient were either automatically fused on True D Semines software or sent via the hospital network to the OSIRIX fusion workstation and Philips Intellispace portal, where the FDG-PET and CT data sets were automatically fused. Pancreatic lesions were assessed on PET and CT scans for every patient, both independently and after fusion. SUV_{max} [maximum standardized uptake value], was used as a quantitative indicator of the extent of FDG uptake at identified lesions. This was carried out by placing circular ROI with diameter 2 cm in average over the most pancreatic lesion active part. We considered any area of increased FDG uptake more than liver parenchyma [used as reference of FDG uptake] as pancreatic neoplastic lesion:

Standard of reference was the pathology of all included pancreatic cancer patients served as gold standard of reference. We evaluated the sensitivity, specificity, and accuracy for, DWI- MRI, and FDG-PET based on histological results as gold standard.

Statistical Analysis of data: SPSS v27 was used for statistical analysis [IBM©, Armonk, NY, USA]. Histograms and the Shapiro-Wilks test were employed to assess the data distribution's normality. The mean and standard deviation [SD] were used to display quantitative parametric data. Frequency and percentage were used to display the qualitative factors. Statistical significance was defined as a two-tailed P value < 0.05. The Pearson correlation coefficient was used to perform correlations. The area under the curve [AUC] for accuracy of the ADC ratio in the diagnosis of pancreatic cancer was calculated using receiver operating characteristic [ROC] curve analysis. The optimum cut-off values were used to calculate sensitivity, specificity, positive predictive value, and negative predictive value. Kappa Interpretation: [< 0: Poor agreement, 0.0 – 0.20: Slight agreement, 0.21– 0.40: Fair agreement, 0.41 – 0.60: Moderate agreement, 0.61 – 0.80: Substantial agreement, 0.81– 1.00: Almost perfect agreement].

RESULTS

This study included 30 patients of both sexes who had histologically proven pancreatic cancer. Their age ranged from 44 to 74 years, with a mean [±SD] of 62.73 [±6.78] years. A total of 8 [27%] females and 22 [73%] males present. All of the patients underwent a DW-MRI, ADC and 18 FDG-PET/CT. ADC means of pancreatic lesion ranged from 0.8 to 1.5 $x10^{-3}$ with mean value [±SD] of 1.1 [±0.33] $x10^{-3}$. ADC means for normal pancreatic tissue ranged from 1.6 to 3 $x10^{-3}$ with mean value [±SD] of 1.93[±0.35] $x10^{-3}$. [Pancreatic lesion/Normal pancreatic tissue] ADC ratio ranged from 0.31 to 0.82 with mean value [±SD] of 0.58 [±0.12]. Lesions with ADC mean value < 1.3x 10^{-3} [the higher cut-off value reported in literature] detected in 25 [83.33%] patients [Figure 2], while 5 [16.66%] patients had lesions with ADC mean value higher than reported cut-off values [1.3x 10^{-3}] [Figure 3].

SUV max for pancreatic lesions ranged from 2.7 to11.5 with mean value [±SD] of 6.26 [±2.55]. SUV max for hepatic reference ranged from 1.9 to 3.5 with mean value [±SD] of 2.51 [±0.41]. Lesions with SUV max higher than the liver, considered as malignant, were detected in 27 [90%] patients [Figures 3,4], while 3 [10%] patients had lesions with SUV_{max} lower than the liver [Figure 6] [Table 1].

ADC means lower than 1.3 can diagnose pancreatic cancer with 83.33% Sensitivity and 83.33 % Accuracy. Pancreatic lesions with SUV max higher than liver reference can diagnose pancreatic cancer with 90% Sensitivity and 90% Accuracy. Both PET/CT scan and MRI can diagnose pancreatic cancer with 93.33% Sensitivity and 93.33% Accuracy [Table 2].

Regarding Agreement, there was a moderate agreement between ADC mean and SUV max in diagnosis of pancreatic cancer of the studied patients [kappa =0.429 and P value=0.014] Regarding Accuracy, ADC_{mean} can diagnose pancreatic cancer of the studied patients as SUV_{max} with 88.89% Sensitivity, 66.67% specificity, 96.00% PPV, 40.00 % NPV and 86.67 % Accuracy [Table 3].

There was a negative correlation between ADC mean and SUV max of the pancreatic lesions [r=-0.491 and P value=0.005]. [Figure 6]. ADC ratio can diagnose pancreatic cancer at cut off ≤0.69 [AUC =0.856 and P value=0.006] with 88.00 % sensitivity, 80.00 % Specificity, 95.7 % PPV and 57.1% NPV [Table 4 - Figure 2].

Table [1]: Radiological investigations of the study patients

		N =30
MRI		
ADC mean for pancreatic lesion [$x10^{-3}$]	**Mean ±SD [min. -max.]**	**1.1±0.3; [0.8 - 1.5]**
ADC mean for normal pancreatic tissue [$x10^{-3}$]	**Mean ±SD [min. -max.]**	**1.93±0.35 [1.6 – 3]**
Pancreatic lesion/ normal pancreatic tissue] ADC ratio	**Mean ±SD [min. -max.]**	**0.58±0.12 [0.31 - 0.82]**
ADC cut of value 1.3x $x10^{-3}$ for diagnosis of pancreatic cancer	**>1.3**	**5 [16.66%]**
	<1.3	**25 [83.33%]**
FDG-PET/CT		
SUV max pancreatic lesion	**Mean ±SD [min. -max.]**	**6.26±2.55 [2.7 - 11.5]**
SUV max hepatic reference	**Mean ±SD [min. -max.]**	**2.51±0.41 [1.9 - 3.5]**
Liver reference for diagnosis of pancreatic cancer	**<liver**	**3 [10 %]**
	>liver	**27 [90 %]**

DWI: Diffusion-weighted imaging, ADC: Apparent diffusion coefficient, SUV: standardized uptake value, FDG-PET/CT: Fluorodeoxyglucose [FDG]-positron emission tomography.

Table [2]: Validity of considering 1.3 as ADC cut-off value, liver activity and both PET/CT scan and MRI as reference for diagnosis of pancreatic cancer

	Sensitivity [%]	Accuracy [%]
ADC	83.33%	83.33%
SUV max	90.00%	90.00%
Both PET/CT scan and MRI	93.33%	93.33%

Table [3]: Agreement between ADC final diagnosis and SUV max final diagnosis of suspected pancreatic cancer of the studied patients

		SUV max final diagnosis		P value
		Negative	Positive	Kappa= 0.429 P value=0.014*
ADC final diagnosis	Negative	2 [66.67%]	3 [11.11%]	
	Positive	1 [33.33%]	24 [88.89%]	
Total		3	27	
Sensitivity	Specificity	PPV	NPV	Accuracy
88.89%	66.67%	96.00%	40.00 %	86.67 %

*Significant as P value ≤0.05, PPV: Positive predictive value, NPV: Negative predictive value.

Table [4]: Role ADC ratio in diagnosis of pancreatic cancer of the studied patients

Variable	Cut off	Sensitivity	Specificity	PPV	NPV	AUC	P value
ADC ratio	≤0.69	88.00 %	80.00 %	95.7 %	57.1%	0.856	0.006*

*: Significant as P value <0.05, PPV: Positive predictive value, NPV: Negative predictive value, AUC: Area under the curve

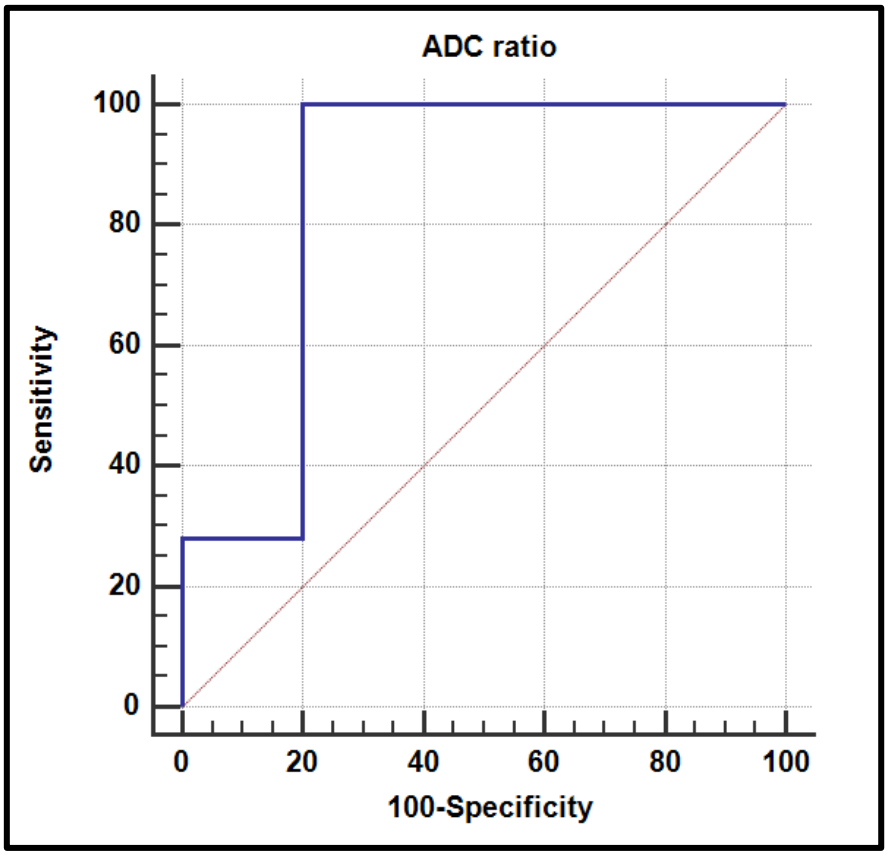

Figure [2]: ROC curve of ADC ratio in diagnosis of pancreatic cancer of the studied patients

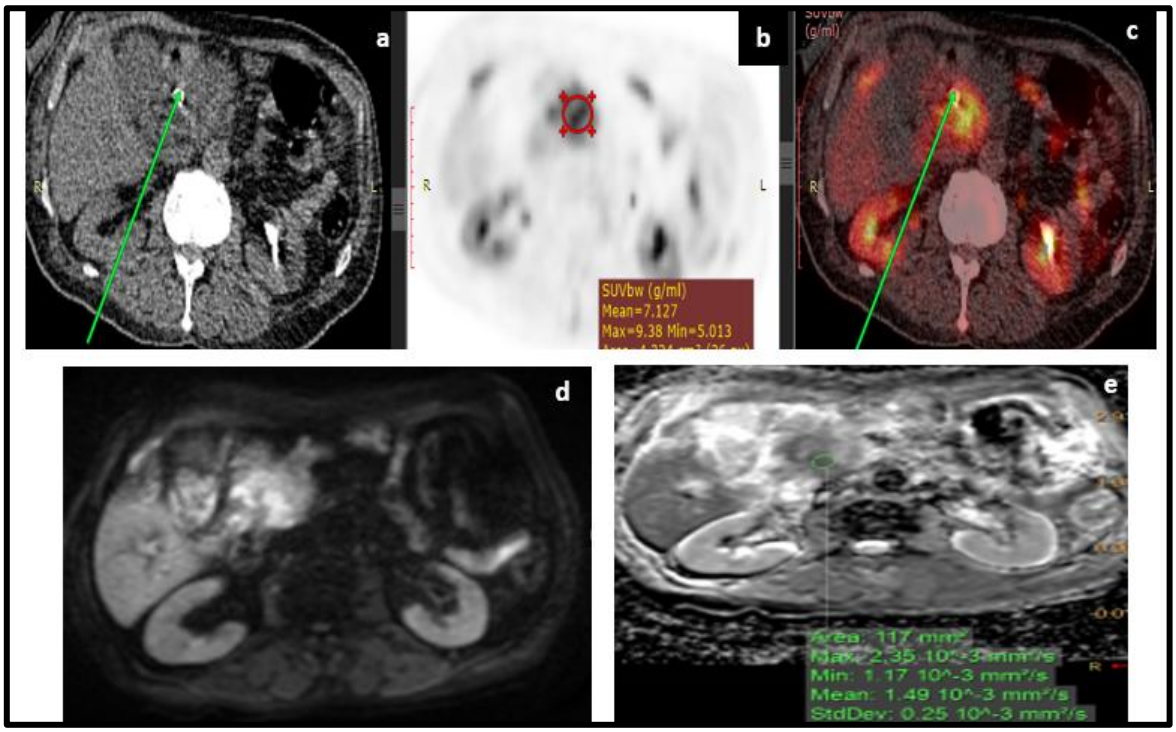

Figure [3]: [a] CT axial cuts of pancreas showing pancreatic head and uncinate process lesion. [b] FDG-PET MIP axial image of pancreas showing increased metabolic activity corresponding to pancreatic head and uncinate process lesion with SUVmax 9.3. [c] Fused PET-CT axial image at the level of pancreas showing increased metabolic activity of the visualized pancreatic head and uncinate process lesion. DWI axial cuts of pancreas showing pancreatic head and uncinate process lesion with adjacent lymph nodes, seen eliciting high signal on DWI. [e] ADC axial cuts showing pancreatic head and uncinate process lesion eliciting low signal on ADC with ADC mean value of 1.4.

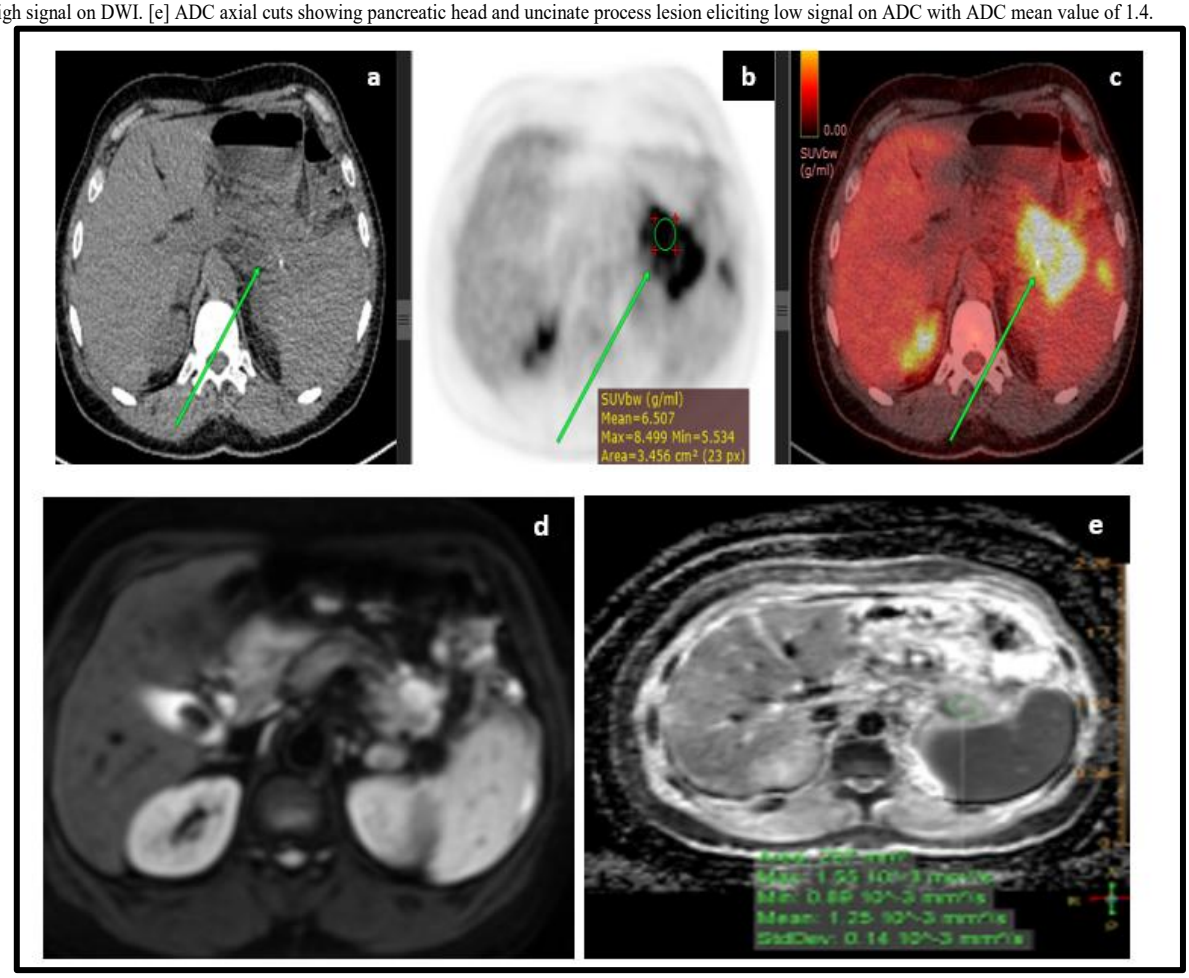

Figure [4]: [a] Axial CT image showing pancreatic tail lesion. [b] Axial MIP FDG-PET image showing hypermetabolic pancreatic tail lesion with SUVmax 8.4. [c] Axial fused PET-CT image at the same level showing the hypermetabolic pancreatic tail lesion. [d] Axial DWI showing increased signal of pancreatic tail lesion. [e] Axial ADC image showing relative decreased signal of pancreatic tail lesion with ADC mean value of $1.2x10^{-3}$.

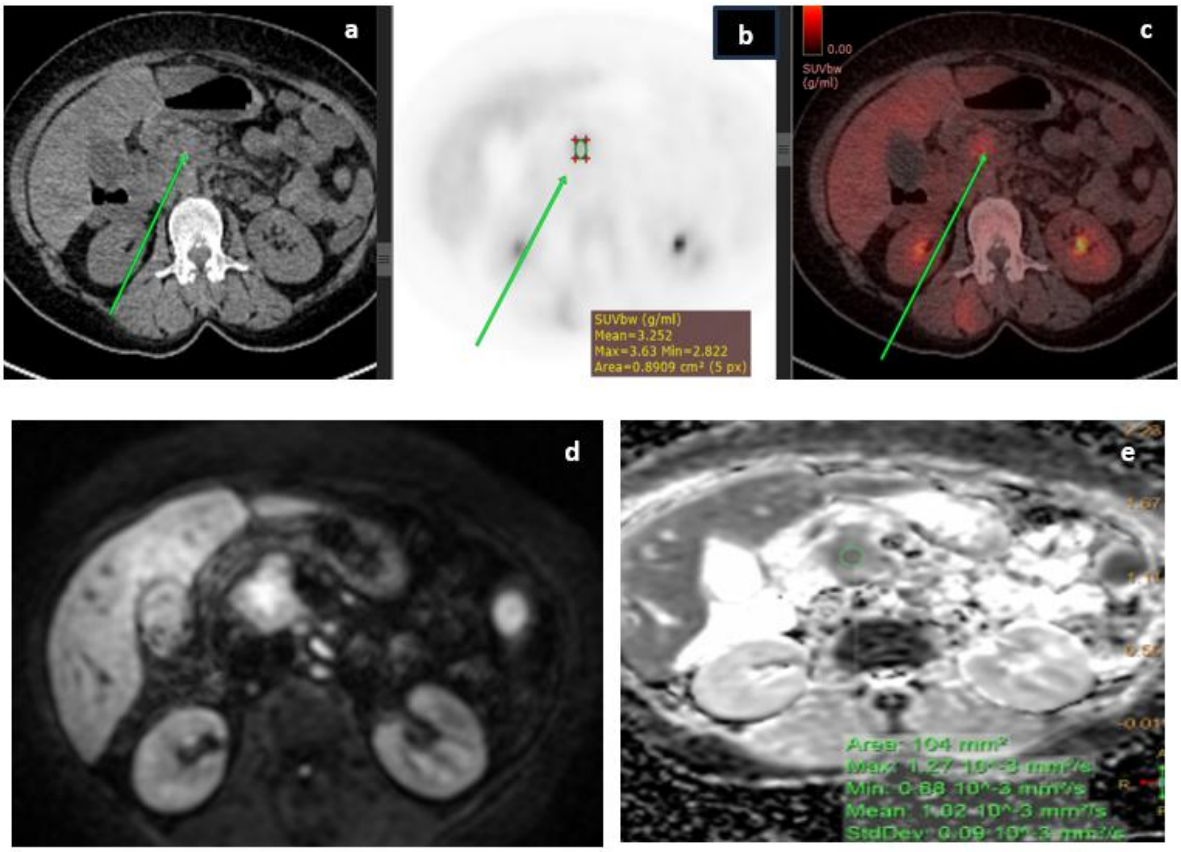

Figure [5]: [a] CT axial cuts of pancreas showing pancreatic head and uncinate process lesion. [b] FDG-PET MIP axial image of pancreas showing low grade metabolic activity corresponding to pancreatic head and uncinate process lesion with SUVmax 3.5. [c] Fused PET-CT axial image at the level of pancreas showing mild metabolic activity of the visualized pancreatic head and uncinate process lesion. [d] DWI axial cuts of pancreas showing pancreatic head and uncinate process lesion, seen eliciting high signal on DWI. [e] ADC axial cuts showing pancreatic head and uncinate process lesion eliciting low signal on ADC with ADC mean value of $1.0x10^{-3}$.

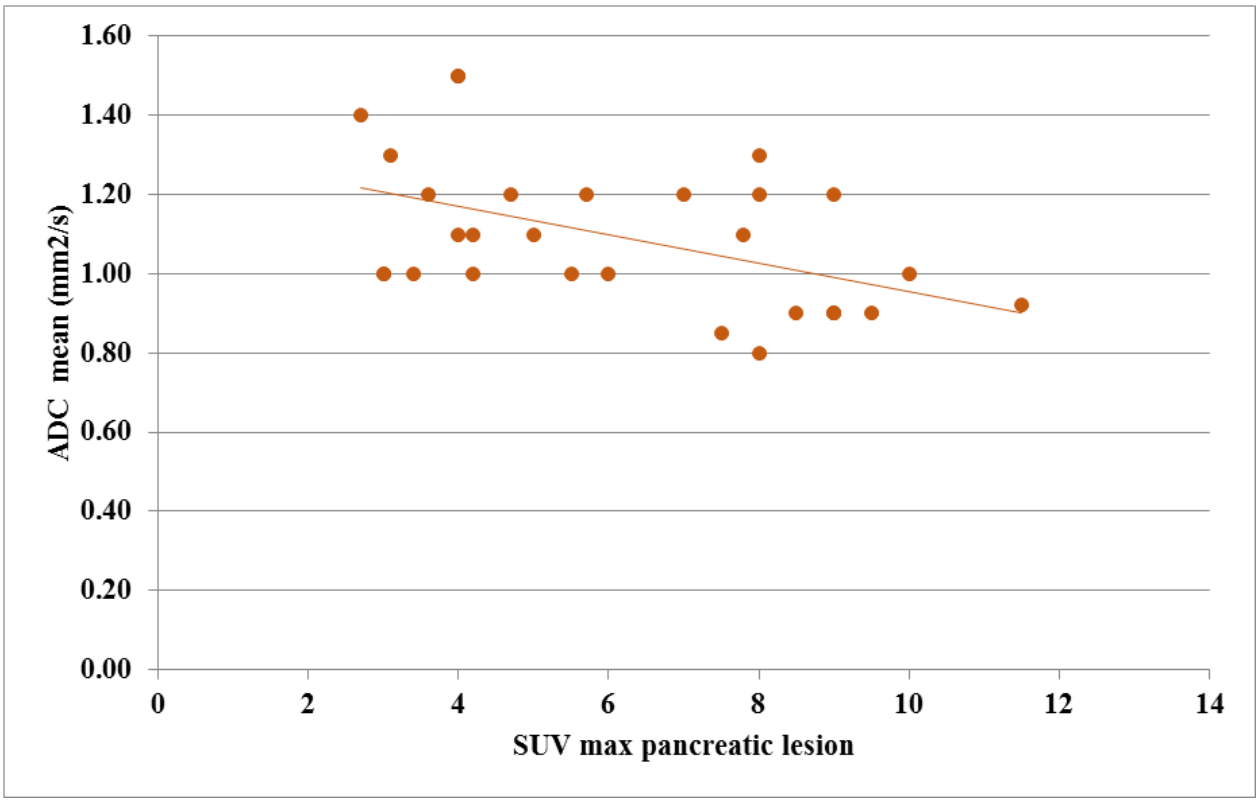

Figure [6]: Correlation between ADC mean and SUV max of pancreatic lesions of the studied patients

DISCUSSION

The current study was designed to evaluate the relationship between ADC of magnetic resonance imaging and SUV of 18F-FDG PET/CT in evaluation of patients with histologically proven pancreatic cancer. 30 patients of both sexes who had proven pancreatic cancer were included. Our study showed that, ADC value for pancreatic lesions ranged from 0.8 to $1.5x10^{-3}$ mm^2/sec with mean value [±SD] of 1.1 $x10^{-3}$ mm^2/sec [±0.33]. ADC for normal pancreatic tissue ranged from 1.6 to $3x10^{-3}$ mm^2/sec with mean value [±SD] of $1.93x10^{-3}$ mm^2/sec [±0.35]. Pancreatic lesion/ normal [Pancreatic tissue ADC ratio] ranged from 0.31 to 0.82 with mean value [±SD] of 0.58 [±0.12]. Regarding diagnosis of pancreatic cancer using ADC cut off value reported in literature [1.3x $x10^{-3}$ mm^2/sec], we detected 25 [83.33%] patients were true positive and 5 [16.66%] patients were false negative with 83.33% sensitivity and 83.33% accuracy.

In agreement to our results, **Abo Seif *et al.*** [8] stated that the ADC value of malignant pancreatic tumors was significantly lower than that of the normal pancreas with mean values of 1.27×10^{-3} mm^2/sec ±0.21 and 1.61×10^{-3} mm^2/sec ±0.13 respectively.

Additionally, **Farchione *et al.*** [9] reported that apparent diffusion coefficient was calculated in the 29 lesions. Twenty-five tumors were solid and had a significantly lower ADC mean value [1.58 x 10^{-3} mm^2 /sec ± 0.20] than those of the normal adjacent parenchyma [2.34x 10^{-3} mm^2 /sec ± 0.33]. Four tumors had a higher ADC mean value: 3 lesions with cystic structure [2.48 x 10^{-3} mm^2 /sec ± 0.28] and 1 lesion with fibrotic structure due to multiple surgical/ medical/radiation therapies [3.18 x 10^{-3} mm^2 /sec ± 0.42].

In this study, the SUV max of pancreatic lesion ranged from 2.7 to 11.5, with a mean value [±SD] of 6.26 [±2.55]. The SUV max of the liver reference ranged from 1.9 to 3.5, with a mean value [±SD] of 2.51 [±0.41]. Diagnosis of pancreatic cancer according to SUV max higher than liver reference revealed 3 [10%] patients were false negative and 27 [90%] patients were true positive with 90% Sensitivity and 90% Accuracy. In agreement with our results, **Abdulaziz *et al.*** [10] reported that false negative rate was 14% with sensitivity of PET- SUV in prediction of malignant lesion in the pancreas was 81% and accuracy 82%.

In contrast to our study, in the study by **Sun *et al.*** [11], they found that the sensitivity of SUV of PET/CT in the diagnosis of cancer of pancreas were relatively low 67.5% and explained that due to the high value of pre- therapy SUV [5.49]. Moreover, Sakane et al. [12] showed that the averaged SUVmax values were low measuring 4.0 [CI, 3.3–4.6] and 3.3 [CI, 2.7–3.8] which revealed false negative results.

In this research, there was a negative correlation between ADC mean and SUV max in pancreatic lesions [r = -0.491, P = 0.005]. There was moderate agreement between ADC and SUV max in diagnosing pancreatic cancer among the studied patients [kappa = 0.429, P = 0.014]. In line with our results, **Gao *et al.*** [13] noticed that the correlations between PET parameters and the measured ADC values were different in malignant tumors, benign lesions, or mixed. They concluded that in pancreatic tumors, the correlation between diffusion constraint and glucose uptake is adversely intermediate. Greater glucose absorption capacity and less water molecule diffusion are indicators of increased malignancy in pancreatic tissue. Additionally, **Sakane *et al.*** [12] exhibited that there was a substantial negative correlation between SUV max and ADC mean [r = −0.50, P = 0.024].

In contrast to our study, **Gao *et al.*** [13] reported that there was a weak correlation [r=-0.389, p=0.016] in malignant tumors and an intermediate correlation [r=-0.525, p<0.01] in mixed analysis. The focus of the research could be the cause of the variation in correlation strength. As **Gao *et al.*** [13] differentiated between malignant and benign lesions, reporting distinct correlation patterns for each. The variations in observed correlation strengths may be due to the approach of categorizing tumors separately, as benign lesions exhibited no significant relationship, while malignant tumors and mixed cases showed different degrees of negative correlation. disparities in results may be explaining the discrepancies in findings.

In our study, pancreatic lesion/normal pancreatic tissue ADC ratio diagnosed pancreatic cancer at a cutoff ≤0.69 [AUC = 0.856, P = 0.006] with 88.00% sensitivity, 80.00% specificity, 95.7% PPV and 57.1% NPV compared to 83.33% Sensitivity and 83.33 % Accuracy for ADC value alone. This matched **Koc and Erbay** [14] study which included a total of 108 consecutive patients [age 60 ± 12.5 years] with 127 pathologically confirmed diagnoses of abdominal lesions. The lesion ADC to normal parenchyma ADC ratio is more accurate than using lesion ADC alone for differentiation, and they discovered that it better differentiated between benign and malignant lesions for b600, b1000, and multiple b2. **Zhang *et al.*** [15] found that although there is no significant difference in their specificity, the ADC value together with the mass-to-non-mass adjacent pancreatic parenchyma [NAP] ratio of ADC value has a higher sensitivity than the mass ADC value alone. Also, **Mourad *et al.*** [16] assessed how beneficial adding DWI to conventional MRI in the identification, characterization, and prognostic assessment of PDAC.

In the present study, combination of both PET/CT scan and MRI can diagnose pancreatic cancer with 93.33% sensitivity and 93.33% accuracy which is higher diagnostic accuracy than PET/CT or MRI alone. CT and MRI are the most widely utilized clinical diagnostic tools for pancreatic cancer. Both CT and MRI have great sensitivity in detecting pancreatic cancer [96% VS 93.5%], despite CT being the first-line imaging modality for this diagnosis. On MRI, tumor respectability is better, with accuracy rate of 86.8% compared to 78.9% [17].

However, with the extensive investigation and study of pancreatic cancer, PET/MRI also offers special benefits for pancreatic cancer diagnosis. Studies by **Tatsumi *et al.*** [18] showed that in comparison to PET/CT alone [88.4%], the diagnosis accuracy of fused PET and DW/MRI imaging for pancreatic cancer was 93.0% and 90.7%, respectively.

The main limitation in our study were a single institution, which may limit the generalizability of the findings, the small sample size [30 patients] reduces the statistical power of the study, the exclusion of critically ill patients and those with MRI contraindications may introduce selection bias, and potential confounding factors such as prior treatments, tumor differentiation, and metabolic conditions were not extensively analyzed.

In conclusion, there was a significant negative correlation between ADC values from DW MRI and SUV max from 18F-FDG PET/CT in pancreatic cancer. We detected moderate agreement [kappa = 0.429] and strong diagnostic performance of ADC pancreatic cancer/normal pancreatic parenchyma ratio [cutoff ≤0.69, AUC = 0.856]. SUV max from 18F-FDG PET/CT and ADC values from DW MRI can diagnose pancreatic cancer with 90% and 83.33 % accuracy receptively. Higher sensitivity and accuracy [93.33%] of combined DW MRI and18F-FDG PET/CT reinforce the

complementary value of both studied in tumor assessment. However, there were several limitations, the study was conducted at a single institution, which may limit the generalizability of the findings.

The small sample size [30 patients] reduces the statistical power of the study. The retrospective nature of some data collection could introduce bias. The study did not evaluate the impact of tumour heterogeneity on imaging parameters. Blood glucose levels, which can influence SUV max values, were not strictly controlled in all patients.

The lack of a standardized threshold for SUV max and ADC values across different imaging devices may affect reproducibility. The study did not include long-term follow-up to assess the prognostic value of ADC and SUV max.

A multimodal imaging approach is recommended, though larger studies are needed to validate these findings. We recommend future studies in multiple centres with larger sample sizes to improve generalizability. Further research should explore the role of ADC and SUV max in differentiating between benign and malignant pancreatic lesions, machine learning algorithms integrating ADC and SUV max could be developed to enhance diagnostic accuracy, Investigating the impact of tumor heterogeneity on imaging parameters may provide additional insights into pancreatic cancer biology.

Long-term follow-up studies should be conducted to evaluate the prognostic value of ADC and SUV max in predicting treatment response and survival, Comparative studies with other imaging modalities, such as contrast- enhanced MRI, should be performed to assess their relative diagnostic value, Inclusion of critically ill patients in future studies could provide a more comprehensive understanding of real-world diagnostic challenges.

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