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SCINTIMETRIC CHARACTERIZATION OF PRIMARY TUMORS BY DUAL PHASE PETCTSTUDY

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ABSTRACT

Aim: This retrospective analysis of the scintimetric characterization of the primary tumors of various cancers using the dual phase PETCT scans thrives to establish the utility of the Rong's Retention ratio and the DrV.Siva's modification of RRI.

Methods: In the proven cases of various cancers the SUV max values were obtained in the Early and Delayed PETCT scans using the ROI method over the FDG avid primary sites. The PETCT scans were done using the GE Discovery IQ unit one and 4 hours after the I.V injection of 5 to 10 mCi of F18- FDG after overnight Fasting. The image analysis and the SUV were calculated using the Advantage 4.7 software provided by GE. Total of 19 primary sites at various locations were included and the calculated SUV max were used to arrive at the Rongs Retention Index(RRI) and Dr.V.Siva's modification of RRI. The values were tabulated and analyzed.

Results: The Rong's retention ratio had a very narrow range with wide overlapping. However the Dr.V.Siva's modification of RRI showed much wider values with a definite cut off level. The statistical evaluation of the data confirm that the Dr.V.Siva's modification of RRI significantly correlates well with the Rong's Retention Index (RRI).

Conclusion: It can be concluded that the scintimetric characterization of the primary tumors of various cancers is possible and might be useful in the identification of the primary malignancies.

KEYWORDS : Primary sites, Dual phase PETCT, Scintimetric Characterization, Rong's Retention Index (RRI) , Dr.V.Siva's modification of RRI.

INTRODUCTION

The utility and advantage of the dual phase PETCT evaluation in the tumor detection was reported by Kuboto K et al (1). The optimal time interval between the early and delayed phase PETCT scans had been proved to be 3 hr post injection by Chen Y.M et al (2). In our study protocol the delayed PETCT was conducted at 4 hours post injection due to logistic reasons.

Rong et.al reported a quantitative estimation to differentiate between the benign and malignant bone lesions using the dual phase PETCT evaluation termed as Rong's Retention Index (3). The Rong's retention index (RRI), computed as follows: RRI=(SUVmaxD−SUVmaxE)× 100/SUVmaxE. Even though this demonstrated significant difference between the benign and malignant bone lesions there was significant overlap between them. In order to make the process simple Dr.V.Siva's modification of RRI was introduced as follows RRI= SUVmaxD / SUVmaxE × 100.

MATERIALS AND METHOD:

Patients

This study was initiated in May 2019, 19 patients (7 males, 27females; age range, 9–76 years;median age, 46±18 years with positive metabolically active primary lesions of various cancers. Each research subject gave his or her consent before participating in the study for the 4 hr delayed PETCT without additional injection of F18-FDG.

F-18 FDG PET image acquisition and reconstruction The study protocol was approved by our institutional ethics committee and informed consent was obtained in all cases. Patients were fasted for at least 4–6 h before intravenous administration of 185–370 MBq of F-18 FDG (4 MBq/kg of body weight). A serum glucose concentration was obtained before the injection and the blood glucose levels were less than 200 mg/dl in all patients. The patients were at rest in a quiet room after the injection and the PET/CT scans were performed at 1 h (early) and 4 h (delayed) post injection with a PET/CT unit (Discovery PETCT ; Wipro GE Medical Systems). The CT image acquisition was performed by spiral CT at 0.75 s per rotation with 40 mAs and 120 kVp, a section thickness of 4 mm, and a 4-mm interval. No intravenous contrast agent was administered. The PET emission images (early images) were acquired from the proximal thigh to the mid cranium,typically requiring six to seven bed positions with a 2-min acquisition in each position. Delayed PET emission images of the abnormal areas were acquired at 4 h after the administration of F-18 FDG, using two or three bed positions with a 2-min acquisition in each position. All PET images were reconstructed using an LOR algorithm, with CT-based attenuation correction applied. Integrated images were obtained by Advantage 4.7 Volume Viewer software.

PET image interpretation and calculation of related parameters Early and delayed PET images ly evaluated the F-18 FDG uptake semiquantitatively.

For semiquantitative analysis, a circular region of interest (ROI) was placed over the identified bone lesion using the transverse PET image. For lesions visualized on PET, the ROIs were placed over the entire F-18 FDG-avid lesion, including the largest amount of radioactivity. The standardized uptake value (SUV) was calculated using the following formula: SUV=tissue concentration(MBq/g) / [injected dose (MBq)/body weight(g)]. The maximal SUV (SUVmax) in the lesion ROI was calculated for each ROI. Furthermore, we evaluated the change in the uptake in the lesions as the retention index (RI), computed as follows: RI=(SUVmaxD−SUVmaxE)×100/SUVmaxE . The Dr.V.Siva's modification of RRI was calculated as follows RRI= SUVmaxD / SUVmaxE × 100. The values were tabulated and analyzed.

RESULTS:

The early and delayed SUV values, the derived Rong's Retention Ratio and Dr.V.Siva' modified Rong's Retention Ratio values are shown in the Table 1 and Table 2.

TABLE - 1

PRIMARY SITE	VIEWS	EARLY	DELAYED	RONGS RR	Dr.V.Siva modi
RT.ADNEXAL	Axial	24.7	28.9	17	117
	Coronal	24	29.1	21.2	121
	Saggital	24.7	30.1	21.8	121
Retro Peri Sa	Axial	11.4	16.1	41.2	141
	Coronal	9.1	12.3	35.1	135
	Saggital	12.3	14.5	17.8	117
PROSTATE	AXIAL	10	12.1	21	121
	Coronal	12.3	12.1	8.1	98.3
	Saggital	13.1	14.5	10.6	110
RECTAL	AXIAL	11	15.2	38.1	138
	Coronal	10.6	15.1	42.4	142
Breast Primary	AXIAL	16.7	29.6	77.2	177
	Coronal	12.1	24.3	100	200
	Saggital	19.8	29.6	49.4	149
Lactating Brest	AXIAL	9.3	9.9	6.4	106
	Coronal	10.3	10	-2.9	97
UTERINE Mass	AXIAL	20.7	40.7	96.6	196
	Coronal	23.9	38.8	62.3	162
	Saggital	26.1	45.4	73.9	173
Rectal	Axial	12.9	15.4	19.3	119
RT.lung	Axial	4.4	6.6	50	150
sigmoid	Axial	14.9	19	27.5	127
Rectal	Axial	17.9	27.5	53.6	153
Rectal	Axial	12.6	14.6	15.8	115
Prostate	Axial	13.1	12.1	-7.6	92.3
Rectal	Axial	8.4	16.1	91.6	191
	Coronal	6.1	13	113	213
	Saggital	12	15.8	31.6	131
	Axial	11.4	16.9	48.2	148
	Coronal	9.6	12.1	26	126
Caecal lesion	Axial	31.3	50.2	60.3	160
Extra Gonadal	Axial	18.7	25.4	35.8	135
	Coronal	23.3	27.2	16.7	116
	Saggital	23.9	27.9	16.7	116
	Axial	23.4	29.7	26.9	126
Rt.fibular	Axial	7.3	9.75	33.5	133
	Coronal	8.2	9.3	13.4	113

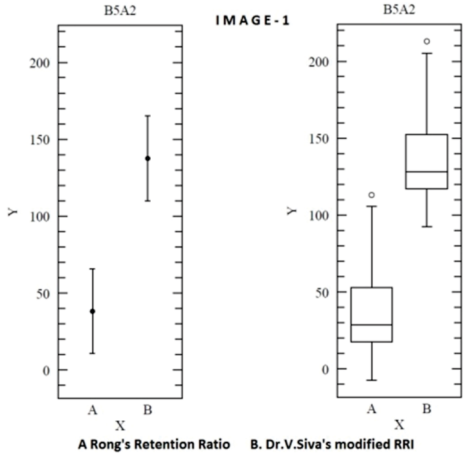
TABLE - 2

PRIMARY SITE	VIEWS	EARLY	DELAYED	RONGS RR	Dr.V.Siva modi
	Saggital	8.6	10.1	17.4	117
Tongue	Axial	13.5	14.7	8.8	108
Esophagus	Axial	16.8	18.4	9.5	109
Esophagus	Axial	16.8	21.1	25.5	125
	Coronal	14.6	18.9	29.4	129
	Saggital	7.9	9.9	25.3	125
Gall bladder	Axial	8.5	13.9	63.5	163
RECTAL	Axial	17.6	30.2	71.5	171
Esophagus	Axial	13	15.2	16.9	116
Uterus	Axial	13.2	15.3	15.9	115
	Coronal	10.1	12.8	26.7	126
SR Lesion	upper	12	23.6	96.6	196
	mid	12.6	17.6	39.6	139
	lower	11.9	19.3	62.1	162
	Sagittal	12.8	23.6	84.3	184
	Coronal	11.1	18.7	68.4	168
Ext.Nod.Semi	Axial	23.8	28.6	20.1	120
	Axial 2	23.4	28.6	22.2	122
	Coronal	23.7	29.7	25.3	125
	Sagittal	23.3	29.5	26.6	126
RGGIST	Axial	6	8.4	40	140
	Coronal	6	8.4	40	140
	Sagittal	6	8.4	40	140

DISCUSSION:

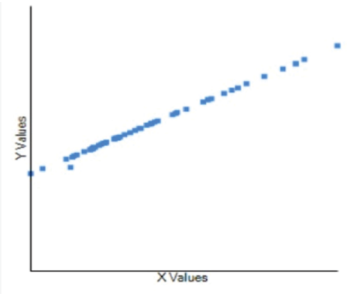
The dual time point based quatintifications of metabolic uprates in 18F-FDG PET had been reported by den hoff et.al (4). The potential diagnostic role of dual phase 18F-FDG PETCT scanning was reported by Jones c etal (5). This is the first study reporting the findings of the dual phase PETCT in the evaluation and characterization in various primary lesions. The Rong's Retention values showed a wide ranging values and no definite cut off value could be arrived at. But the Dr.V.Siva's modification of Rong's Retention Ratio revealed that the cut off value to be 100 and above for confirming the malignant nature of the lesions. The statistical evaluation of the values by Student t Test showed good p value confirming the significance that the two values were identical as shown by the Image 1.

IMAGE-1



A Rong's Retention Ratio B. Dr.V.Siva's modified RRI

The Pearson correlation evaluation reveals there is a strong positive correlation, which means that high x variable scores go with high y variable scores and vice versa as shown in Image 2.



Pearson Correlation Coefficient The value of R is 0.999.

The inclusion of the various primary malignancies in both the sexes adds advantage to the study. However the non-inclusion of primary benign lesions in the study is the greatest disadvantage. The other limitations being the single institutional study and the small number of patient population.

CONCLUSIONS

It can be concluded that the Scintimetric characterization of the primary lesions into benign and malignant types utilizing the Dr.V.Siva's modification of Rong's Retention ratio in the dual phase PETCT evaluation is worth pursuing. This concept must be put to critical analysis in various other conditions and it many other institutions to make this into a useful clinical entity.

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