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Contents

Thrice Monthly Volume 10 Number 34 December 6, 2022

FIELD OF VISION

MINIREVIEWS

ORIGINAL ARTICLE

Clinical and Translational Research

Case Control Study

Retrospective Study

World Journal of Clinical Cases

Thrice Monthly Volume 10 Number 34 December 6, 2022

Contents

World Journal of Clinical Cases

Thrice Monthly Volume 10 Number 34 December 6, 2022

Contents

World Journal of Clinical Cases

Thrice Monthly Volume 10 Number 34 December 6, 2022

Contents

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ORIGINAL ARTICLE

Retrospective Study

Significance of incidental focal fluorine-18 fluorodeoxyglucose uptake in colon/rectum, thyroid, and prostate: With a brief literature review

Haejun Lee, Kyung-Hoon Hwang

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Abstract

BACKGROUND

Fluorine-18 fluorodeoxyglucose positron emission tomography/computed tomography (F-18 FDG PET/CT), a functional imaging method, is usually performed on the entire torso, and regions of unexpected suspicious focal hypermetabolism are not infrequently observed. Among the regions, colon, thyroid, and prostate were found to be the common organs in a recent umbrella review. Some studies reported that a high rate of malignancy was shown in incidentally identified focal hypermetabolic regions and suggested that further examinations should not be ignored.

AIM

To investigate the malignancy rate of incidental focal FDG uptake, useful PET parameters and their cutoffs in discrimination between malignant and benign lesions.

METHODS

Retrospectively, the final reports of 16510 F-18 FDG PET/CT scans performed at our hospital between January 2016 and March 2022 were reviewed to identify incidentally observed FDG uptake in the colon/rectum, thyroid, and prostate. The scans of patients with current or prior malignancies at each corresponding location, without the final reports of histopathology or colonoscopy (for colon and rectum) for the corresponding hypermetabolic regions, or with diffuse (not focal) hypermetabolism were excluded. Finally, 88 regions of focal colorectal hypermetabolism in 85 patients (48 men and 37 women with mean age 67.0 ± 13.4 years and 63.4 ± 15.8 years, respectively), 48 focal thyroid uptakes in 48 patients (12 men and 36 women with mean age 62.2 ± 13.1 years and 60.8 ± 12.4 years, respectively), and 39 focal prostate uptakes in 39 patients (mean age 71.8 ± 7.5

years) were eligible for this study. For those unexpected focal hypermetabolic regions, rates of malignancy were calculated, PET parameters, such as standardized uptake value (SUV), capable of distinguishing between malignant and benign lesions were investigated, and the cutoffs of those PET parameters were determined by plotting receiver operating characteristic curves.

RESULTS

In the colon and rectum, 29.5% (26/88) were malignant and 33.0% (29/88) were premalignant lesions. Both SUVmax and SUVpeak differentiated malignant/premalignant from benign lesions, however, no parameters could distinguish malignant from premalignant lesions. Higher area under the curve was shown with SUVmax (0.752, 95%CI: 0.649-0.856, $P < 0.001$) and the cutoff was 7.6. In the thyroid, 60.4% (29/48) were malignant. The majority were well-differentiated thyroid cancers (89.7%, 26/29). The results of BRAF mutation tests were available for 20 of the 26 well-differentiated thyroid cancers and all 20 had the mutation. Solely SUVmax differentiated malignant from benign lesions and the cutoff was 6.9. In the prostate, 56.4% (22/39) were malignant. Only SUVmax differentiated malignant from benign lesions and the cutoff was 3.8. Overall, among the 175 focal hypermetabolic regions, 60.6% (106/175) were proven to be malignant and premalignant (in colon and rectum) lesions.

CONCLUSION

Approximately 60% of the incidentally observed focal F-18 FDG uptake in the colon/rectum, thyroid, and prostate were found to be malignant. Of the several PET parameters, SUVmax was superior to others in distinguishing between malignant/premalignant and benign lesions. Based on these findings, incidental focal hypermetabolism should not be ignored and lead physicians to conduct further investigations with greater confidence.

Key Words: Incidental; Focal; Uptake; Fluorine-18 fluorodeoxyglucose; Positron emission tomography/computed tomography; Standardized uptake value

Core Tip: Unexpectedly identified uptake on fluorine-18 fluorodeoxyglucose positron emission tomography/computed tomography (F-18 FDG PET/CT) is not a rare finding. Among the uptakes, focal uptake may have clinical implications by harboring malignant lesions. In this study, the clinical significance of the incidentally identified focal FDG uptake in the colon/rectum, thyroid, and prostate was investigated with the malignancy rate, comparison of PET parameters, and receiver operating characteristic curve. Overall, approximately up to 60% were malignancies (including premalignancy) for the regions and SUVmax was a superior PET parameter in discrimination between malignant/premalignant and benign lesions. The findings should lead physicians to conduct further investigations more confidently without ignoring the focal uptake.

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INTRODUCTION

Fluorine-18 fluorodeoxyglucose positron emission tomography/computed tomography (F-18 FDG PET/CT) is an established and widely used imaging modality for the evaluation and follow-up of various cancers. It is an imaging examination that principally provides functional information, which is new or additional, as compared to conventional computed tomography or magnetic resonance imaging, which mainly provides anatomical information[1,2]. The fused F-18 FDG PET/CT provides the extent and intensity of FDG metabolism on precise structural information compared to PET alone. As PET/CT is usually performed on the entire torso, regions of unexpected suspicious focal hypermetabolism are not infrequently observed among patients undergoing the scan for known existing or newly diagnosed diseases. Incidental focal hypermetabolism can be observed in virtually any area of the scan-covered body. Unexpected focal hypermetabolic locations that have been widely studied include colon/rectum [3-5] and thyroid[6-8]. Likewise, a recent umbrella study reported the three most common organs for incidental FDG uptake were the colon, thyroid, and prostate (colon, 1.95% and 2.03%; thyroid, 1.85%;

parotid, 0.42%; breast, 0.30%; prostate, 1.48%)[9]. Based on the findings, this study was conducted retrospectively at our hospital to investigate the malignancy rate of incidental focal FDG uptake, PET parameters and their cutoffs in distinguishing between malignant and benign lesions in colon/rectum, thyroid, and prostate; and ultimately whether these findings can help physicians in clinical field. Finally, a brief literature review on the clinical significance of incidental focal hypermetabolism is presented together.

MATERIALS AND METHODS

Patients

The final reports of 16510 F-18 FDG PET/CT scans performed at our hospital between January 2016 and March 2022 were retrospectively reviewed to identify incidentally observed FDG uptake in the colon/rectum, thyroid, and prostate. The scans of patients with current or prior malignancies at each corresponding location, without the final reports, as a gold standard, of histopathology or colonoscopy (for colon and rectum) for the corresponding hypermetabolic regions, or with diffuse hypermetabolism were excluded. Finally, 88 regions of focal colorectal hypermetabolism in 85 patients (48 men and 37 women with mean age of 67.0 ± 13.4 years and 63.4 ± 15.8 years, respectively), 48 regions of focal thyroid uptake in 48 patients (12 men and 36 women with mean age of 62.2 ± 13.1 years and 60.8 ± 12.4 years, respectively), and 39 regions of focal prostate uptake in 39 patients (mean age: 71.8 ± 7.5 years) were eligible for this study.

F-18 FDG PET/CT imaging

The image quality of F-18 FDG PET/CT is known to be affected by blood glucose levels owing to the structural similarity between FDG and glucose. As high blood glucose levels can result in less FDG uptake into cells because of competition between blood sugar and FDG for glucose transport protein [10], all patients were required to fast for 4–6 h prior to the scan, and their blood glucose levels were checked to acquire optimal image quality. The examination was rescheduled for patients with blood glucose levels ≥ 11 mmol/L (200 mg/dL). PET/CT scan was performed 60 min after the injection of 185 MBq F-18 FDG intravenously. Images from the base of the skull to the mid-thighs were acquired using a dedicated PET/CT scanner (Biograph mCT 128; Siemens Healthcare GmbH, Erlangen, Germany). The PET scans were acquired using the step and shoot method for 3 minutes per bed, and the CT scans using the continuous spiral mode with activated CareDose4D and CARE kV functions based on 60 mAs and 120 kVp, respectively, to acquire individually optimized images and reduce radiation exposure to the patients. No contrast material was used for the CT scans. PET and CT images were reconstructed using the iterative reconstruction method, and the final fused PET/CT images were generated on a dedicated image-processing workstation supplied with the PET/CT unit.

Analysis of the PET/CT images and histopathological reports

The selected images of eligible patients were thoroughly reviewed by two nuclear medicine physicians, one with over two decades of experience. When an unexpected focal hypermetabolic region was identified in the colon/rectum, thyroid, or prostate, the patient's medical records were searched to obtain a final histopathological report of the corresponding location. The lesions identified visually were classified histopathologically as malignant, benign, or, additionally, premalignant for colorectal lesions. A semi-quantitative PET parameter called standardized uptake value (SUV), and metabolic tumor volume (MTV) for these lesions were measured to obtain maximum SUV (SUVmax), peak SUV (SUVpeak), hypermetabolic tumor volume, and mean SUV of the hypermetabolic tumor volume (mSUVmtv). When measuring the MTV, various volumes of interest can be set using different values of the SUV threshold. In this study, several SUV thresholds, ranging from 2 to 5 in increments of 0.5, were used to obtain multiple MTVs and the mean SUV of each MTV with specific SUV threshold # (MTV# and mSUVmtv#, respectively). Finally, total lesion glycolysis (TLG) was calculated by multiplying the volume by the mSUVmtv. Measurements of these parameters were performed on a dedicated PET/CT workstation equipped with a SyngoMMWP (Siemens Healthcare GmbH). The measured values were compared among the malignant, premalignant (in colon/rectum), and benign lesions. Receiver operating characteristic (ROC) curves were plotted to determine cutoff values.

Statistical analysis

Parametric (Student's *t*-test) and non-parametric (such as Mann–Whitney *U* test) methods were used to compare the measured or calculated values of the classified lesions. The cutoff value for differentiating malignant/premalignant from benign lesions was determined by plotting the ROC curve and obtaining the area under the curve (AUC). Statistical analysis was performed using SPSS for Windows (version 16.0; SPSS, Inc., Chicago, IL, United States). Statistical significance was set at $P < 0.05$.

Literature search

The literature search for this article was conducted using databases such as PubMed, EMBASE, Scopus, MEDLINE, Web of Science, and search engines like Google Scholar and ScienceDirect.

Ethics

This retrospective study was approved by the Institutional Review Board of our hospital (IRB No. GAIRB2020-297) and the requirement for informed consent was waived. The study was conducted in accordance with the tenets of the 1964 Declaration of Helsinki and its later amendments.

RESULTS

The demographic features of the patients with incidental focal colon/rectum, thyroid, and prostate hypermetabolic lesions classified by histopathological report are shown in Table 1.

Colon and rectum

Among the 88 eligible regions of focal hypermetabolism, 26 were diagnosed with malignant lesions and 29 premaligncies. The remaining 33 were benign. To be specific, 29.5% (26/88) of the cases had malignant lesions that consisted of 25 adenocarcinomas and one neuroendocrine tumor. Premalignant lesions comprised 33.0% (29/88) and consisted of 23 tubular (79.3%), 2 villous (6.9%), and 4 tubulovillous (13.8%) adenomas. The remaining 33 (37.5%) benign hypermetabolic regions included inflammation or physiologic uptake. Both SUVmax and SUVpeak differentiated malignant/premalignant from benign lesions. No PET parameters could differentiate malignant from premalignant lesions. SUVmax showed higher AUC (0.752, 95% confidence interval (CI) 0.649-0.856, $P < 0.001$) than SUVpeak, and a cutoff was 7.6 (sensitivity of 0.673, specificity of 0.676).

Thyroid

Forty-eight focal hypermetabolic regions were identified as nodules on ultrasonography (US) and confirmed histopathologically. Of those lesions, 60.4% (29/48) were malignant, and the remaining 39.6% (19/48) were benign. Among the malignancy cases, 86.2% (25/29) were papillary, 3.4% (1/29) follicular, 3.4% (1/29) poorly differentiated, and 6.9% (2/29) Hurthle cell cancer. Additionally, BRAF mutation test results were available for 20 of the 26 well-differentiated (papillary and follicular) thyroid cancer lesions, and all 20 lesions were confirmed to have the mutation. Only SUVmax differentiated malignant from benign lesions. AUC was 0.676 (95%CI: 0.521-0.832, $P = 0.025$) with a cutoff of 6.9, sensitivity of 0.630, and specificity of 0.632.

Prostate

There was a total of 8800 male patients. Sixty-nine had incidental focal hypermetabolism in the prostate, and 39 had histopathologic report of the corresponding region. Among the 39 focal hypermetabolic regions, 56.4% (22/39) were malignant (adenocarcinoma) and 43.6% (17/39) were benign (hyperplasia or benign prostatic tissue) lesions. Only SUVmax differentiated malignant from benign lesions. AUC was 0.706 (95%CI: 0.544-0.868, $P = 0.026$) and a cutoff was 3.8 (sensitivity of 0.591, specificity of 0.588). Figure 1 shows an example of incidental focal prostate uptake, which was diagnosed as adenocarcinoma in a patient with known non-small cell lung cancer.

Overall, 175 incidental focal hypermetabolic regions with final histopathological results were identified in those organs. Among the regions, 106 (60.6%, 106/175) were proven to be malignant and premalignant (in colon and rectum) lesions. Figure 2 shows a brief graphical presentation of the results. SUVmax superiorly distinguished malignant/premalignant from benign lesions with statistical significance. Figure 3 and Table 2 show the ROC curves, AUCs, and cutoffs.

DISCUSSION

Incidental focal FDG uptake

Unexpected suspicious focal hypermetabolic FDG uptake is not an uncommon finding in clinical PET/CT studies and many papers on such the incidental focal FDG activities have demonstrated varying results for colorectal[11-13], thyroid[14-16], and prostate[17-19] regions. Nuclear medicine physicians or radiologists sometimes have trouble interpreting imaging findings and recommending further investigation to clinicians when they face ambiguous metabolism in unexpected regions. It would be a great help to have standards or criteria for judgement. The uptake of radiopharmaceuticals can be measured and represented as the SUV. The SUV is a representative semi-quantitative parameter of PET. The higher the SUV, the more likely it is to be malignant or have advanced disease or poor prognosis/overall survival in various cancers[20-23]. This study assessed the clinical significance of

Table 1 Demographic features of patients with incidental focal hypermetabolism in colon/rectum, thyroid, and prostate

Lesion	Status	Men, *n*, (age, yr, mean ± SD)	Women, *n*, (age, yr, mean ± SD)	Total, *n*, (age, yr, mean ± SD)
Colon/rectum	Malignant	17 (70.5 ± 11.1)	8 (72.5 ± 14.1)	25 (70.8 ± 12.0)
	Premalignant	22 (68.1 ± 6.3)	7 (67.6 ± 17.4)	29 (67.9 ± 9.9)
	Benign	9 (60.7 ± 14.3)	22 (58.7 ± 14.6)	31 (59.3 ± 14.3)
Thyroid	Malignant	10 (61.1 ± 13.1)	19 (58.7 ± 10.7)	29 (59.8 ± 11.1)
	Benign	2 (67.5 ± 16.3)	17 (61.2 ± 13.1)	19 (61.9 ± 13.1)
Prostate	Malignant	22 (74.1 ± 7.7)	N/A	N/A
	Benign	17 (68.8 ± 6.1)	N/A	N/A

SD: Standard deviation.

Table 2 AUCs and cutoffs for malignant colorectal[1], thyroid, and prostate lesions

Lesion	SUV	AUC	95% confidence interval	*P* value	Cutoff	Sensitivity	Specificity
Colorectal	SUVmax	0.752	0.649-0.856	$P < 0.001$	7.6	0.673	0.676
	SUVpeak	0.729	0.62-0.836	$P < 0.001$	6.2	0.673	0.706
Thyroid	SUVmax	0.676	0.521-0.832	$P = 0.025$	6.9	0.63	0.632
Prostate	SUVmax	0.706	0.544–0.868	$P = 0.026$	3.8	0.591	0.588

[1]Focal colorectal uptake includes both malignant and premalignant lesions.
AUC: Area under the curve; SUV: Standardized uptake value.

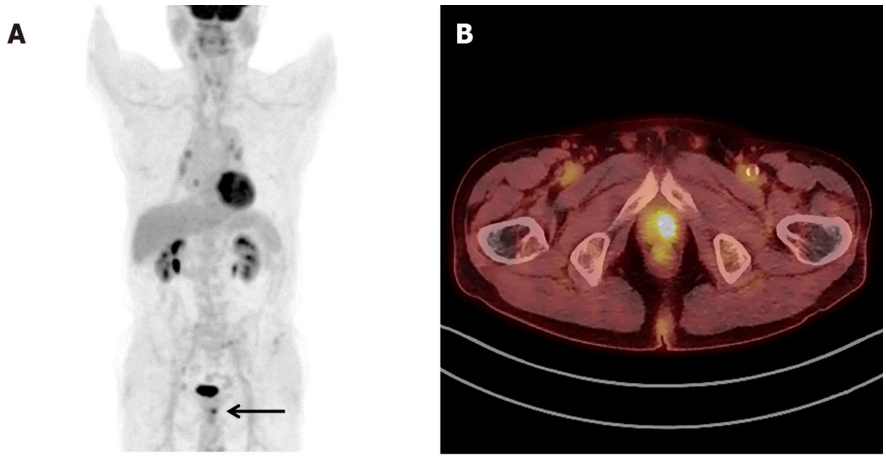

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Figure 1 A case of malignant incidental focal prostate fluorine-18 fluorodeoxyglucose uptake. A: Focal uptake (black arrow) below the radioactivity of bladder on the maximum intensity projection image of a 76-year-old man diagnosed with non-small cell lung cancer; B: Axial image of fused positron emission tomography/computed tomography showing hypermetabolism (maximum standardized uptake value 8.1) in the left prostate region and histopathologically confirmed as an adenocarcinoma of the prostate gland.

incidental focal FDG uptake in the colon/rectum, thyroid, and prostate by comparing the several PET parameters and the results suggested that SUVmax was the most useful parameter as it differentiated malignant and premalignant from benign lesions better than other parameters for all the evaluated organs. Cutoffs for SUVmax were also obtained and they may help in decision-making. The following are about our experience and a brief review of the literature on incidental focal F-18 FDG uptake in colorectal, thyroid, and prostate tissues.

Colon and rectum

The incidental FDG uptake in the colon or rectum ranged from 0.90% to 4.75% in patients undergoing

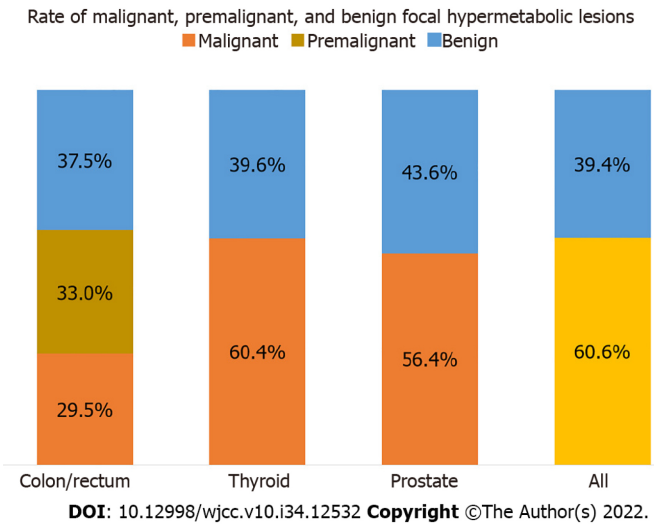

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Figure 2 Rates of malignant, premalignant (in colon and rectum), and benign incidental focal hypermetabolic fluorine-18 fluorodeoxyglucose uptake in the colon/rectum, thyroid, and prostate. "ALL" indicates benign (39.4%) and malignant/premalignant (60.6%) lesions.

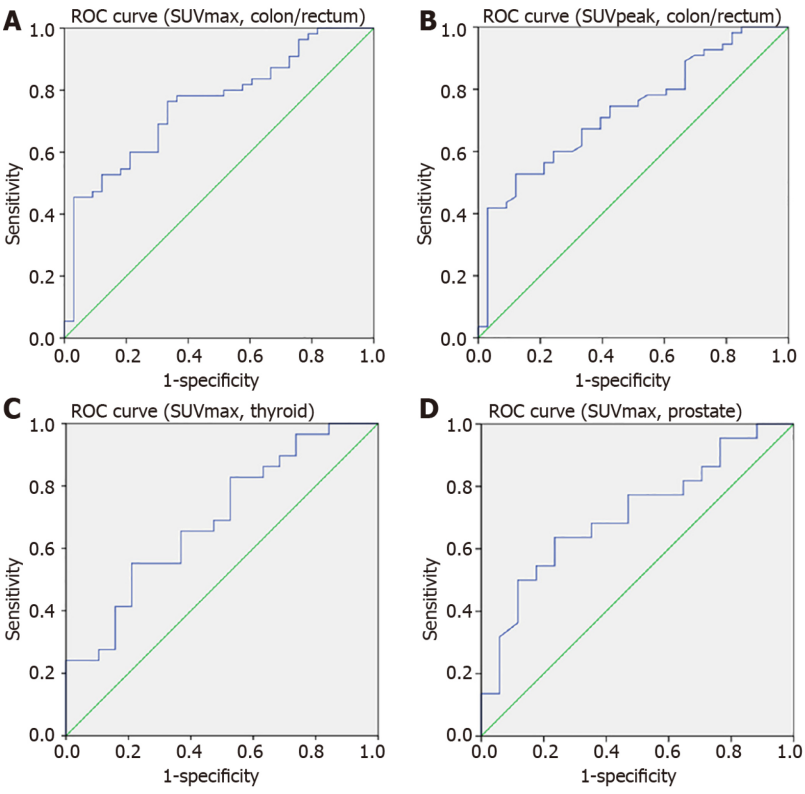

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Figure 3 Representative receiver operating characteristic curves. A: Standardized uptake value (SUV)max of colon/rectum; B: SUVpeak of colon/rectum; C: SUVmax of thyroid; D: SUVmax of prostate. Area under the curves are 0.752, 0.729, 0.676, and 0.706, respectively. ROC: Receiver operating characteristic.

evaluation for non-gastrointestinal disease[24-26]. The uptake may be diffuse, segmental, or focal and studies have shown that a focal pattern of incidental FDG uptake is more likely to be malignant than a non-focal pattern[12]. Diffuse and segmental patterns of uptake are generally considered to have a low risk of malignancy and usually result from inflammation, physiologic uptake, or radiopharmaceutical excretion[27,28]. In other words, incidental focal colorectal FDG uptake may represent benign, premalignant, or malignant lesions[13,29] and various articles have reported inconsistent results on the malignant risk of incidental focal colorectal FDG uptake. Of the 88 eligible lesions in this study, 55 (62.5%) were malignant (29.5%, 26/88) or premalignant (33.0%, 29/88) lesions, comparable to other studies[13]. Among the investigated PET parameters, SUVmax was better at discriminating between

malignant/premalignant and benign lesions than other parameters, and had the highest AUC as well. As nearly two-thirds of the unexpected focal colorectal hypermetabolic regions turned out to be malignant/premalignant lesions, such a region warrants further investigation. On the other hand, some issues have been raised. Some patients without any significant colorectal FDG uptake were found to have malignant or premalignant lesions on colonoscopy[30]. As there are cancers that are not FDG-avid, aside from the radiation exposure, F-18 FDG PET/CT is considered to be of little use as an initial workup modality for such non-FDG-avid cancers. However, it was recently reported that in patients with incomplete preoperative colonoscopy due to stenotic left-sided colorectal cancer, the finding of negative FDG-avid lesions in the proximal colon ensures the absence of additional lesions[31]. Some researchers reported that whole-body FDG PET imaging-based health screening programs could successfully detect various cancers including colorectal cancers in early stages[32] and that FDG PET was a satisfactory complementary diagnostic test, together with colonoscopy, for colorectal cancer in patients with incomplete colonoscopy[33]. Hence, it would be useful to perform FDG PET for the surveillance of patients after colorectal cancer surgery or for screening subjects at high risk for colorectal cancer.

Thyroid

The number of diagnoses of thyroid cancer has been increasing for several decades, and part of it is identified incidentally (thyroid incidentaloma) by several imaging studies, including F-18 FDG PET/CT. Well-differentiated thyroid cancers (papillary and follicular types) account for more than 85% of all thyroid cancers[34,35] and are known to be less aggressive, with a better prognosis than other types of thyroid cancer such as poorly differentiated thyroid cancer, anaplastic thyroid cancer, or Hurthle cell cancer. However, up to 5% of well-differentiated thyroid cancers may become dedifferentiated and aggressive[36,37]. Dedifferentiated thyroid cancer becomes less-/non-iodine-avid and, therefore, less responsive to radioactive iodine therapy. FDG is easily taken up by aggressive tumor cells due to the elevated expression of glucose transporter 1 (GLUT-1). As slow-growing well-differentiated types are the majority of thyroid cancers, they are generally less FDG-avid and F-18 FDG PET/CT has a limited role in the initial workup. Instead, this metabolic imaging is considered for the evaluation of recurrence in cases with suspicious serum thyroglobulin level without significantly abnormal findings on US or iodine whole-body scans after thyroidectomy or iodine therapy.

It was reported that approximately 2.5%-5% of subjects who underwent F-18 FDG PET/CT had thyroid incidentallomas, and 25%–50% of focal hypermetabolic thyroid incidentallomas were histopathologically confirmed to be malignant[38-40] including rare metastasis from other cancers[41-43]. Diffuse incidental FDG uptake is more likely to indicate benign lesions such as thyroiditis or hypothyroidism [44,45]. In this study, over half of the focal hypermetabolic thyroid incidentalomas (60.4%, 29/48) were diagnosed as malignant lesions, and therefore, further investigation is suggested. Although 89.7% (26/29) of histopathologically proven malignant lesions were well-differentiated thyroid cancers, they were identified on PET/CT. Considering that there were 20 cases of BRAF mutation out of 26 well-differentiated thyroid cancers (the remaining six had no BRAF test), the relationship between visualization on imaging and the mutation could be carefully expected.

SUVmax was the sole parameter that could distinguish malignant from benign lesions and none of other parameters were successful. On the other hand, some papers on thyroid incidentalomas suggested that other PET parameters such as MTV or TLG were useful[14,16,46].

Prostate

It is generally accepted that the FDG uptake in normal prostate is relatively low and the degree of uptake may overlap in prostate cancer, benign prostate hyperplasia, and normal prostate; F-18 FDG PET/CT is not commonly advocated in detection or initial staging of primary prostate cancer[47,48]. Although the limited role of F-18 FDG PET/CT is generally expected in the evaluation of prostate cancer, incidentally observed focal FDG uptake in the prostate may have clinical implications[17-19,49].

In our study, 69 cases (0.78%, 69/8800) with incidental hypermetabolism of the prostate were observed. Of those, 30 cases did not have histopathological report and excluded from this study. Contrary to other studies, SUVmax distinguished malignant from benign lesions with statistical significance and no other parameters succeeded. However, it is thought that the SUVmax of malignant (6.0 ± 4.8) and benign (3.4 ± 0.9) lesions overlap relatively much and possibly resulted in relatively low sensitivity and specificity for the cutoff. This may have an association with the results of other studies that described SUVmax was of little help in discrimination. Nevertheless, based on the high rate of malignancy (56.4%, 22/39) of the incidental focal hypermetabolism in this and other studies[49-51], further evaluation for the uptake can be emphasized.

Limitations

This study was conducted retrospectively at a single institution. A possibility of bias may exist in the selection of research subjects. Firstly, only visualized hypermetabolic lesions were included in the study. Non-FDG-avid malignant or benign lesions which are indistinguishable from the environment were excluded naturally. Secondly, depending on the image reader, only a very clear high uptake can be

judged as a lesion and recorded in the report. As the final reports were reviewed first to collect suspicious hypermetabolic regions, uptakes that were less significant to the reader might not have been recorded in the report and not included. Thirdly, what may seem significant to the reader may not be meaningful to the clinicians or patients, and the observed incidental focal hypermetabolism may not lead to pathological report. These factors may lead to a higher rate of malignancy.

There are several known non-FDG-avid malignant lesions, such as well-differentiated thyroid cancers. On the other hand, some benign lesions such as Hurthle cell adenoma of thyroid were reported to have high FDG uptake[52-54]. Both cases make a discrimination between malignant and benign lesions difficult. This study included several cases of prostate cancer with relatively low values of SUVmax (< 3.0) and a few benign Hurthle cell adenomas with high SUVmax that might have affected the results in an unwanted way.

The qualitative reading of F-18 FDG PET/CT images mainly relies on the naked eye, and because the non-specific nature of FDG, it is not simple to distinguish malignant from benign hypermetabolic lesions, therefore, it sometimes would not be fully confident for the image readers to recommend further workup. Several FDG PET parameters help suggest a high malignancy potential on the basis of (semi) quantitative values. Although there are some limitations, the high rate of malignancy in incidental focal hypermetabolic regions and the derived cutoffs in this study can help recommend further workup with elevated confidence.

CONCLUSION

Incidental focal F-18 FDG uptake was observed in the colon/rectum, thyroid, and prostate and had malignancy rates of up to 60%. Among the several PET parameters, SUVmax presented its ability in distinguishing malignant/premalignant from benign lesions. These findings should attract physicians in clinical fields and lead them to conduct further investigations confidently without ignoring the unexpected focal uptake.

ARTICLE HIGHLIGHTS

Research background

Regions of unexpected hypermetabolism were not rare findings on fluorine-18 fluorodeoxyglucose positron emission tomography/computed tomography (F-18 FDG PET/CT). There are studies on the incidentally identified FDG uptake and some suggested a high possibility of malignancy.

Research motivation

A confirmation of high malignancy rate in incidentally observed focal FDG uptake may assist physicians to conduct further investigations more reliably and confidently.

Research objectives

To investigate the malignancy rate, useful PET parameters and their cutoffs in discrimination between malignant and benign lesions for the assessment of clinical implications of the incidentally identified focal F-18 FDG uptake.

Research methods

The final reports of 16510 F-18 FDG PET/CT scans performed at our hospital between January 2016 and March 2022 were retrospectively reviewed to identify incidentally observed FDG uptake in the colon/rectum, thyroid, and prostate. Eighty-eight regions of colon/rectum, 48 regions of thyroid, and 39 regions of prostate were eligible for this study. For the total of 175 regions, the classification as malignant, premalignant, or benign was performed according to the final histopathological reports. PET parameters such as maximum and peak standardized uptake values (SUVmax and SUVpeak), MTV, mean SUV of metabolic tumor volume (mSUVmtv), and TLG were measured or calculated for the regions and compared among the malignant, premalignant, and benign lesions. ROC curves were plotted to determine the cutoff values for the parameters.

Research results

For the incidental focal colorectal hypermetabolic regions, 62.5% (55/88) had malignant or premalignant lesions. Both SUVmax and SUVpeak differentiated malignant/premalignant from benign lesions. No PET parameters involved in this study could differentiate malignant from premalignant lesions. SUVmax showed higher AUC than SUVpeak and had a cutoff of 7.6. For thyroid, 60.4% (29/48) of the cases were malignant. A high rate (89.7%, 26/29) of well-differentiated thyroid cancers were identified on FDG PET. BRAF mutation test results were available for 20 of 26 well-differentiated thyroid cancers

and all 20 were confirmed to have the mutation. SUVmax alone differentiated malignant from benign lesions and a cutoff was 6.9. For prostate, 56.4% (22/39) were malignant. Only SUVmax differentiated malignant from benign lesions and a cutoff was 3.8. Overall, of the 175 focal hypermetabolic regions with final histopathological reports, 60.6% (106/175) were proven to be malignant or premalignant (in colon and rectum) lesions.

Research conclusions

Approximately up to 60% of malignancy rate was shown for the incidentally observed focal hypermetabolic uptake in the colon/rectum, thyroid, or prostate. Overall, SUVmax was superior to several other PET parameters in distinguishing between malignant/premalignant and benign lesions. Hence, these findings may lead physicians to conduct further investigations more reliably and confidently.

Research perspectives

A high rate of malignancy in the unexpectedly identified focal FDG uptake may assist the decision-making process for the nuclear medicine physicians, radiologists, and clinical physicians.

FOOTNOTES

Author contributions: Lee H and Hwang KH contributed to this work, designed the research study, performed the research, analyzed the data, and wrote the manuscript; Lee H contributed analytic tools; All authors have read and approved the final manuscript.

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