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Cancer screening of healthy volunteers using whole-body ^{18}F-FDG-PET scans: The Nishidai clinic study ☆

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ABSTRACT

In order to evaluate the diagnostic performance of cancer screening using whole-body ^{18}F-fluorodeoxyglucose positron emission tomography (FDG-PET) scanning for asymptomatic subjects, we conducted a historical cohort study. The study group comprised 5807 individuals who underwent PET scanning from 2002 to 2003. Each subject had carried out a procedure with whole-body ^{18}F-FDG-PET scan with some other diagnostic tests. Out of 5807 participants, data from 4881 subjects were analysed. Among them, PET screening revealed abnormal FDG uptake in 562 subjects, and possible or probable malignancy in 324 subjects, and histological diagnosis of cancer in 36 subjects (16 thyroid, seven colon, four lung, five breast, two prostate, and two others) out of them. The overall cancer detection rate was 0.7%, and PET scanning had a sensitivity of 70.6% and a specificity of 94.0%. This result warrants further prospective cohort studies to evaluate the usefulness of PET cancer screening for cancer prevention.

1. Introduction

Since the 1980s, ^{18}F-fluorodeoxyglucose positron emission tomography (^{18}F-FDG-PET) imaging has been used worldwide for the detection, differential diagnosis, staging and treatment evaluation of cancer. In the United States, since the Health Care Finance Administration (now known as the Centres for Medicare and Medicaid Services) first decided to cover ^{18}F-FDG-PET in 1998, its scope has been expanded to include the diagnosis, staging and re-staging of lung cancer, colon cancer, oesophageal cancer, head and neck cancer, malignant lymphoma and melanoma; and the staging, re-staging and monitoring of treatment for breast cancer.[1] In Japan, reimbursement has been available from the national health insurance fund since April 2002 for the cost of using ^{18}F-FDG-PET in patients with lung cancer, breast cancer, colon cancer, head and neck cancer, brain tumour, pancreatic cancer, malignant lymphoma, metastatic liver cancer, carcinoma with unknown primary origin and malignant melanoma, for whom staging and diagnosis with respect to metastasis and recurrence cannot be confirmed by using other methods of examination and diagnostic imaging.[2]

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In 2000, the diagnostic performance of whole-body ^{18}F-FDG-PET cancer screening was studied in Japan with respect to the screening of asymptomatic individuals, but it was concluded that this method was not suitable for screening the general population because of the substantial cost involved.[3] However, in Taiwan, the use of PET cancer screening is becoming more widespread. A Taiwanese study published in 2001 concluded that, because of its high cost, a longer study period with a larger number of cases is needed to validate the use of FDG- PET study as a cancer screening tool.[4] In another study carried out in 2003, no strong evidence was obtained to support the use of ^{18}F-FDG-PET for routine cancer screening of the general population.[5] But more recently, on the basis of a cancer screening study, Chen et al. concluded that cancer screening using ^{18}F-FDG-PET or PET/CT (1) has high sensitivity and specificity, (2) causes no complications, and (3) is well accepted by patients, except for its relatively high cost.[6] Furthermore, they concluded that cancer screening using ^{18}F-FDG-PET or PET/CT can reduce the need for chemotherapy, and improve patients' survival and quality of treatment by reducing the scope or urgency of surgical procedures, and, thus, even for patients who eventually die from cancer, ultimately reduce their net suffering.[6]

In Japan, cancer screening including whole-body ^{18}F-FDG-PET scanning, helical computed tomography (CT), magnetic resonance imaging (MRI) and tumour marker screening are widely available for healthy people. Despite its high cost, a large number of asymptomatic individuals visit PET cancer screening centres for cancer screening, including not only whole-body ^{18}F-FDG-PET scans, but also scans of specific regions (for example, lung, breast, or abdomen), and some facilities have started to publish results from their screening. There were 97 PET centres in Japan in November 2005,[7] and by 2005, the number of people who had undergone ^{18}F-FDG-PET scanning for cancer detection had exceeded 40,000. In addition, technological innovations, stabilisation of the technology, as well as reduction of the costs are contributing to improve the diagnostic performance of PET scans.[5,6,8,9]

In order to evaluate the diagnostic performance of PET cancer screening, we conducted a historical cohort study for healthy subjects with no history or symptoms of cancer, who visited a PET cancer screening facility.

2. Patients and methods

2.1. Study population

The study population comprised 5807 individuals who underwent cancer screening including PET scanning at Nishidai Clinic Diagnostic Imaging Centre (Tokyo, Japan) from August 1st, 2002, to July 31st, 2003. Subjects were not randomly selected from the general population. Before the screening, all participants answered a questionnaire, which gathered information about prior history of cancers, tumour symptoms, recent history of cancer-related examinations (including those for tumour markers), sex, age and smoking history. The participants' weight, height and blood pressure were measured. Written informed consent for the PET cancer screening was obtained from all participants. Based on the questionnaire responses, 791 subjects with a history of cancer, 103 subjects with symptoms possibly indicating the existence of tumours, and 32 subjects in whom an increase in tumour markers had been observed prior to the screening were excluded from the study; thus, data from a total of 4881 individuals were analysed in the present study. The ethics committee at Nishidai Clinic Diagnostic Imaging Centre approved this study.

2.2. ^{18}F-FDG-PET screening

Before receiving the FDG, subjects were fasted for at least 5 h. After confirming that the subjects had understood and answered the questionnaire correctly and measuring their weight, height, and blood pressure, a 4.625 MBq/kg ^{18}F-FDG injection was administered to the subjects. Whole-body ^{18}F-FDG-PET scanning was started 40–50 min after the injection. ^{18}F was produced using a CYPRIS-HM18 cyclotron (Sumitomo Heavy Industries, Tokyo, Japan), and from this ^{18}F-FDG was synthesised by a ^{18}F-FDG-synthesizer F-100 (Sumitomo Heavy Industries, Tokyo, Japan).

PET images were captured using five Posicam-HZL units (Positron Corporation, Houston, Texas, USA). Images were taken from the area between the upper jaw and the mid-section of the thighs over a period of 60 min.

Other than whole-body ^{18}F-FDG-PET scanning, the screening programme consisted of: a faecal occult blood test (FOB); examination of serum tumour markers (carcinoembryonic antigen (CEA), alpha fetoprotein (AFP), carbohydrate antigen 19–9 (CA19-9), prostate specific antigen (PSA) for male subjects, and carbohydrate antigen 125 (CA125) for female subjects); an electron beam CT scan for the neck, thoracic and abdominal regions; an MRI scan for the pelvic region; and an ultrasound (US) scan for the thyroid, breast and abdominal regions.

Eighteen radiological technologists, four registered medical sonographers, eight registered nurses, two system engineers, and 41 diagnostic radiologists (five full-time and 36 part-time staff) were involved in the screening programme, and five to seven diagnostic radiologists screened, on average, approximately 30 examinees per day.

2.3. Evaluation of ^{18}F-FDG-PET scan

On the basis of the ^{18}F-FDG-PET scanning results, patients were categorised into three groups: those with increased FDG uptake (group 1), those with normal FDG uptake (group 2), and those with a decrease in FDG uptake or changes in the shape of the uptake image, which suggested possible malignancy (group 3). The group with increased FDG uptake was further divided into three subgroups: group 1a (subjects with severely increased FDG uptake, suggesting probable malignancy), group 1b (subjects with moderately increased FDG uptake, suggesting possible malignancy), and group 1c (subjects with mildly increased FDG uptake that was considered benign). Subjects in groups 1a, 1b and 3 were deemed to have possible or probable malignancy (subjects in group 3 were included because of the possibility of brain tumours and urological tumours), and those in group 1c and 2 were considered to have no indications of malignancy. Subjects were categorised on the basis of their reports of PET findings, which were written by one of the experienced radiologists at Nishidai Clinic.

2.4. Evaluation of results from other screening modalities

When results of the FOB test were abnormal, or when tumour marker levels were above their respective cut-off points, possible malignancy was suggested. Some other diagnostic tests were undergone in the centre. Cut-off points for AFP, CA19-9, CEA, PSA, CA125 were 10 ng/mL, 37 U/mL, 4.3 ng/mL, 4.0 ng/mL, and 35 U/mL, respectively.

In electron beam CT, MRI and US scanning, possible malignancy was suggested when tumours or swelling or enlargement were observed.

2.5. Evaluation of outcome

Cancer detection rates from the screening programme were evaluated based on the numbers of definitive diagnosis of cancer within the 1 year following the screening. When malignant or other diseases were suspected as a result of the screening programme, subjects were referred to other hospitals for histological examination and definitive diagnosis. When other abnormality was observed as a result of other modalities, subjects were also referred to them. The results of histological examinations and definitive diagnoses were obtained through reports from these local hospitals, where possible.

2.6. Statistical methods

Subjects who had no records of any further diagnosis were treated as having 'no cancer' in estimating the sensitivity, specificity and positive predictive value (and their respective 95% confidence intervals) of using PET screening for predicting the presence of cancer. SPSS version 11.0.1 (SPSS Inc.) was used to carry out the analysis.

3. Results

3.1. Subject characteristics

Of the 4881 subjects, 2487 were male and 2394 were female (Table 1). The mean age of the subjects was 54.7 years (SD 10.8; range 12–87 years). Subjects aged 50–59 years constituted 37.5% of all subjects, and were the most numerous age group. The subjects' mean weight, height, body mass index (BMI), and systolic and diastolic blood pressure were 60.6 kg (SD 11.8, range 27.6–108.0 kg), 161.8 cm (SD 8.7, range 131.2–191.8 cm), 23.0 (SD 3.3, range 12.0–41.7), 121.2 mmHg (SD 17.4, range 80–208 mmHg), and 74.3 mmHg (SD 10.7, range 40–120 mmHg), respectively. With respect to subjects' smoking habits, non-smokers were the most numerous (41.9%), followed by ex-smokers (27.0%) and current smokers (23.1%). There were 393 subjects (8.1%) who did not provide information about their smoking habits.

3.2. PET scan results for asymptomatic subjects

Among the 4881 subjects, abnormal FDG uptake was observed in 562 subjects (11.5%). Among these, 44 subjects were categorised into group 1a, 277 into group 1b, 238 into group 1c, 4319 into group 2 and the remaining three into group 3 (Table 2). In total, 324 subjects (6.6% of all subjects; 95% CI 6.0–7.4%) were deemed to have probable or possible malignancy on the basis of the PET cancer screening.

Table 1 – Characteristics of the subjects

Factor	
Gender [Number (%)]	
Male	2487 (51.0%)
Female	2394 (49.0%)
Age, years [Number (%)]	
–29	63 (1.3%)
30–39	422 (8.6%)
40–49	896 (18.4%)
50–59	1830 (37.5%)
60–69	1303 (26.7%)
70–	367 (7.0%)
Weight, kg [mean (SD)]	60.6 (11.8)
Height, cm [mean (SD)]	161.8 (8.7)
BMI [mean (SD)]	23.0 (3.3)
Systolic blood pressure, mmHg [mean (SD)]	121.2 (17.4)
Diastolic blood pressure, mmHg [mean (SD)]	74.3 (10.7)
Smoking habit [Number (%)]	
Current smoker	1126 (23.1%)
Former smoker	1319 (27.0%)
Nonsmoker	2043 (41.9%)
Not answered	393 (8.1%)

3.3. Histological diagnosis

Among the 324 subjects, medical reports were obtained for 120 subjects, and among 4286 subjects who had mild or no increase of FDG uptake, medical reports were obtained for 239 subjects. Out of them, definitive diagnoses of cancer were obtained for 51 subjects (1.0% of all subjects; 95% CI 0.8–1.4%: shown in Table 3). Among these, 17 subjects were in group 1a, 19 were in group 1b, and 15 were in group 2. There were 36 subjects (0.7% of all subjects; 95% CI 0.5–1.0%) who were considered to have probable or possible malignancy on the basis of PET cancer screening who also had a definitive diagnosis of cancer. These cases of cancer comprised 16 thyroid cancers (0.33%), seven colon cancers (0.14%), four lung

Table 2 – Type of abnormal FDG uptake

	Total	Cancer proven by histology
Group 1: Abnormal FDG uptake	559	36
Group 1a: Severe increase of uptake that suggested probable malignancy	44	17
Group 1b: Moderate increase of uptake that suggested possible malignancy	277	19
Group 1c: Mild increase of uptake that is considered benign	238	0
Group 2: Normal FDG uptake	4319	15
Group 3: Decrease of uptake or changes in the shape of uptake	3	0
Total	4881	51

Table 3 – Findings on the basis of PET and histological diagnoses for 51 subjects

No.	Age	Sex	Findings by PET	Organ or site	Histological diagnosis	Abnormal findings in other modalities
1	66	F	probable malignancy	thyroid	thyroid papillary carcinoma	thyroid tumour in US
2	54	M	probable malignancy	thyroid	thyroid papillary carcinoma	thyroid tumour in US
3	51	F	probable malignancy	thyroid	thyroid papillary carcinoma	thyroid tumour in CT, US
4	56	F	probable malignancy	thyroid	thyroid papillary carcinoma	thyroid tumour in US
5	70	M	probable malignancy	thyroid	thyroid papillary carcinoma	thyroid tumour in CT, US
6	50	M	probable malignancy	thyroid	thyroid papillary carcinoma	thyroid tumour in CT, US
7	53	F	probable malignancy	thyroid	thyroid papillary carcinoma	thyroid tumour in CT, US
8	55	M	possible malignancy	thyroid	thyroid papillary carcinoma	thyroid tumour in US
9	61	F	possible malignancy	thyroid	thyroid papillary carcinoma	thyroid tumour in US
10	53	F	possible malignancy	thyroid	thyroid papillary carcinoma	thyroid tumour in US
11	56	F	possible malignancy	thyroid	thyroid papillary carcinoma	thyroid tumour in CT, US
12	73	F	possible malignancy	thyroid	thyroid papillary carcinoma	thyroid tumour in US
13	59	F	possible malignancy	thyroid	thyroid papillary carcinoma	thyroid tumour in US
14	59	F	possible malignancy	thyroid	thyroid papillary carcinoma	thyroid tumour in CT, US
15	65	M	possible malignancy	thyroid	thyroid papillary carcinoma	thyroid tumour in US
16	55	M	possible malignancy	thyroid	thyroid papillary carcinoma	thyroid tumour in CT, US
17	47	F	benign/normal	thyroid	thyroid papillary carcinoma	thyroid tumour in US
18	36	F	benign/normal	thyroid	thyroid papillary carcinoma	thyroid tumour in CT, US
19	67	M	benign/normal	thyroid	thyroid papillary carcinoma	*CEA*
20	63	M	probable malignancy	lung	lung squamous cell carcinoma	*CEA*, lung tumour in CT
21	60	F	probable malignancy	lung	lung adenocarcinoma	lung tumour in CT
22	53	F	possible malignancy	lung	lung adenocarcinoma	lung ground grass opacity in CT
23	61	M	possible malignancy	lung	lung adenocarcinoma	–
24	57	F	benign/normal	lung	lung adenocarcinoma	*possible lung cancer in CT*
25	50	F	benign/normal	lung	lung adenocarcinoma	lung nodule in CT
26	58	F	benign/normal	lung	lung adenocarcinoma	lung nodule in CT
27	56	F	probable malignancy	breast	breast cancer	breast tumour in US
28	59	F	probable malignancy	breast	breast cancer	*CEA*, breast tumour in US
29	47	F	possible malignancy	breast	breast cancer (invasive ductal carcinoma)	breast tumour in US
30	50	F	possible malignancy	breast	breast cancer	breast tumour in CT, US
31	59	F	possible malignancy	breast	breast cancer (noninvasive ductal carcinoma)	*CEA*
32	47	F	benign/normal	breast	breast cancer	breast tumour in US
33	69	F	benign/normal	liver	hepatocellular carcinoma	liver tumour in US
34	70	M	possible malignancy	kidney	renal cell carcinoma	renal tumour in CT, US
35	61	M	benign/normal	kidney	renal cell carcinoma	*possible renal cancer in MRI*, renal tumour in CT, US
36	65	M	benign/normal	kidney	renal cell carcinoma	renal tumour in CT, US
37	60	M	benign/normal	kidney	renal cell carcinoma	renal tumour in CT, US
38	66	M	probable malignancy	colon or rectum	ascending colon cancer	*possible ascending colon cancer in CT*
39	77	M	probable malignancy	colon or rectum	sigmoid colon cancer	*FOB*
40	59	F	probable malignancy	colon or rectum	transverse colon cancer	*FOB*, *CEA*, tumour in CT
41	74	M	probable malignancy	colon or rectum	sigmoid colon cancer	*FOB*, wall thickening of colon in CT
42	69	F	possible malignancy	colon or rectum	transverse colon cancer	*CEA*, tumour in CT
43	67	M	possible malignancy	colon or rectum	descending colon cancer	*FOB*
44	62	M	possible malignancy	colon or rectum	multiple colorectal cancer	*FOB*
45	66	M	probable malignancy	prostate	prostate cancer (moderately diff.)	*PSA*, *possible prostate cancer in MRI*
46	60	M	possible malignancy	prostate	prostate cancer	*PSA*, abnormal signal from prostate in MRI
47	54	M	benign/normal	prostate	prostate cancer (moderately diff.)	*PSA*, *possible prostate cancer in MRI*
48	64	M	benign/normal	prostate	prostate cancer (moderately diff.)	*PSA*, abnormal signal from prostate in MRI
49	55	M	benign/normal	prostate	prostate cancer	*PSA*, abnormal signal from prostate in MRI
50	62	M	benign/normal	bladder	bladder cancer	*possible prostate cancer in MRI*
51	61	F	probable malignancy	uterus ovary	double cancer (ovarian cancer & endometrial cancer)	*CA125*, *possible endometrial and ovarian cancer in MRI*

cancers (0.08%), five breast cancers (0.10%), two prostate cancers (0.04%), one renal cell carcinoma (0.02%), and one instance of simultaneous ovarian and endometrial cancer (0.02%). Among these, three cases of colon cancer (0.06%), two cases of lung cancer (0.04%), one case of breast cancer (0.02%), and one (0.02%) case of renal cell carcinoma were at TNM stage I.

Fifteen subjects who were deemed to have normal FDG uptake or benign changes in FDG uptake in the PET cancer screening were histologically diagnosed with cancer within 1 year after the screening. Seven of the fifteen subjects were diagnosed with cancer by screening modalities other than the PET scan. For eight subjects in whom FDG was not accumulated in the PET scan, CT and/or US revealed the presence of nodules. These cases comprised three thyroid cancers, one hepatocellular carcinoma, three lung cancers, one breast cancer, three renal cell carcinomas, three prostate cancers, and one bladder cancer.

3.4. *Results from other screening modalities*

The number of subjects who completed all examinations (PET, FOB, serum tumour markers, CT, MRI and US) was 4588 (2348 male and 2240 female; Table 4). Possible cancer was indicated in 8.8% (429/4798) of subjects by FOB, 2.7% (131/4802) by AFP, 0.2% (8/4802) by CA19-9, 2.6% (125/4802) by CEA, 3.7% (91/2445) by PSA, 1.9% (45/2359) by CA125, 0.1% (7/4771) by CT scanning, and 1.3% (62/4616) by MRI scanning. No subject was suspected of having cancer on the basis of the results of the US scans. Among the subjects for whom malignancy was suspected, a definitive diagnosis of cancer was obtained for five who were suspected on the basis of FOB, six for CEA, five for PSA, one for CA125, two for CT scanning, and five for MRI scanning. No definitive diagnosis of cancer was obtained for any subject who was suspected to have cancer on the basis of AFP or CA19-9 screening.

3.5. *Sensitivity and specificity*

Confirmed diagnosis of cancer was obtained for 1.0% (51/4881) of all subjects who underwent the PET screening programme provided by the Nishidai Clinic Diagnostic Imaging Centre. PET scanning had a sensitivity of 70.6% (36/51) and a specificity of 94.0% (4542/4830), and a positive predictive value of 11.1% (36/324) in predicting the presence of cancer (95% CI 7.9–15.0%; Table 5).

Table 4 – The number of probable/possible malignancies and cancers detected by different modalities

	Tested	Probable/possible malignancy	Cancer proven by histology
FOB	4798	429 (8.9%)	5 (0.10%)
AFP	4802	131 (2.7%)	0
CA19-9	4802	8 (0.2%)	0
CEA	4802	125 (2.6%)	6 (0.13%)
PSA (Male)	2445	91 (3.7%)	5 (0.20%)
CA125 (Female)	2359	45 (1.9%)	1 (0.04%)
CT	4771	7 (0.1%)	2 (0.04%)
MRI	4616	62 (1.3%)	5 (0.11%)
US	4646	0	0
PET	4881	324 (6.6%)	36 (0.74%)

Table 5 – Results of PET findings and definite diagnosis

Findings by PET	N	Histological diagnosis		
		Cancer	Benign / Normal	No histological report
Probable/ possible malignancy	324	36 (11.1%)	84	204
Benign/ normal	4557	15	228	4314
Total	4881	51	312	4518

4. Discussion

Although it was a single-centre study, nearly 5000 subjects who underwent screening in 1 year were examined in the present study, which is greater than the number involved in any previously published study (3165,[3] 1283[5] and 3631[6]). The annual cancer detection rate by using PET cancer screening for an asymptomatic population who voluntarily underwent the screening at Nishidai Clinic Diagnostic Imaging Centre in Tokyo was estimated to be 0.7%. Those who volunteered to undergo screening tests in this centre were retrospectively studied and they were not randomly selected. The characteristics of subjects seemed to be comparable to those in the general population, except for the age distribution and social economical background (Table 1). This rate is similar to the rates determined in other similar studies.[3–6]

All subjects with severe or moderate increase of FDG uptake were referred to other hospitals without any other tests. This referral did not depend on other tests, so did not affect the sensitivity either. Unfortunately some information regarding the histological diagnosis could not be obtained. Some subjects with a negative PET but a positive result in other tests were also referred to histological tests, producing in false negative results (Table 2).

In many cases, there was no response from the hospitals that the patients were referred to. Therefore, when sensitivity and specificity were estimated, these patients were classified as instances of no definite diagnosis in the analysis. But since it is possible that these patients did in fact have cancer, the true sensitivity and true positive predictive value of the technique might be larger if the true diagnoses for these subjects were to be included in the analysis.

In other studies, the estimated sensitivity of PET cancer screening has been found to be 54% (36/67),[3] 83.3% (15/18; with a specificity of 99.8%, 1241/1244),[5] and 80.9% (38/47).[6] The sensitivity of 70.6% and the specificity of 94.0% calculated in the present study are quite similar to these results. Further investigations should be carried out to pinpoint the sensitivity and specificity of PET cancer screening and to establish the most suitable algorithm of diagnostic methods for each organ.

For lung cancer screening, Pastorino et al. demonstrated that low-dose spiral CT with selective addition of PET effectively detects early stage lung cancer in heavy smokers aged 50 years or older.[10] In the present study, three of the seven cases of lung cancer were suggested to be benign or normal in PET cancer screening. In the lung region, negative FDG accumulation can be observed in some well-differentiated adenocarcinomas,[11,12] and, therefore, it is necessary to search for effective detection methods other than FDG-PET for lung cancer.

The sensitivity of PET scans is not sufficient to detect small tumours, and women who are asymptomatic but who clearly have chest tumours or abnormal mammography results can test negative.[13] However, because of improvements in spatial resolution through recent technological innovations, and improvements in sensitivity with the emergence of PET/CT, FDG-PET could become more useful for breast cancer screening in the future.[9] In the present study, five out of six confirmed breast cancer cases were detected by PET cancer screening.

Detection of colon cancer by PET cancer screening has not been studied in detail,[14] because FOB was proven to be a useful cancer screening method in the Minnesota Colon Cancer Control Study, which began in 1975 ,[15] and because increased FDG uptake is sometimes equivocal in the colon or rectum (due to normal uptake by intestinal bacterial flora and muscle), which makes it difficult to detect small lesions.[14] The guidelines for early cancer detection issued by the American Cancer Society (ACS) in 2003 also recommend FOB as a screening method for colon cancer.[16] In the present study, however, all seven patients with colon cancer were suggested as having probable/possible cancer in the PET cancer screening, and, furthermore, one case was not detected by FOB. Based on this result, use of PET scanning for the detection of colon cancer should be studied further.

With respect to head and neck cancer, in a study involving 331 healthy subjects who underwent PET cancer screening, thyroid incidentaloma was found in 3.0% (10/331) of the subjects and one thyroid papillary carcinoma (0.3%) was found.[17] Although the effectiveness of screening methods for head and neck cancer has not been thoroughly explored, PET has been found to have high sensitivity and specificity for detecting cancers in these areas,[18] and should be further studied in the future to confirm that this is the case.

In the present study, one out of four renal cancer cases, two out of five prostate cancer cases and none out of one bladder cancer case were suggested as probable or possible malignancy in the PET cancer screening, and, therefore, it seems that PET screening is not appropriate for detection of these cancers. The PSA test is more or less established as a screening method for prostate cancer,[19] and it is also recommended by the ACS.[16]

We strictly excluded subjects with a history of cancer or probable or possible malignancy because these subjects could have affected our estimates of the cancer detection rate in the present study. The age distribution of the examines was not substantially different from those in other studies.[3–6] Characteristics of subjects with a history of cancer, especially those with early-stage and cured cancer, need to be analysed in order to examine the relationship between these factors and cancer detection by PET.

We attempted to categorise the diagnoses made by the screening. However, strict definition and categorisation of the diagnoses made by CT, MRI, US and PET information was not successfully established. Systematic diagnostic algorithms need to be explored in the future in order to evaluate the effectiveness of screening programmes. Although Japanese national guidelines for the use of PET in cancer screening were published in November 2004 by the Japanese Society of Nuclear Medicine and the Board for Promoting Clinical PET,[20] the guidelines were supported by scant empirical evidence, thus making their use problematic. Considering these problems, further prospective studies should be conducted in the future. In fact, a prospective study is currently being carried out in Japan, and the questions raised here could possibly be answered to some degree by that study.[21,22]

5. Conclusion

In PET cancer screening at Nishidai Clinic Diagnostic Imaging Centre, cancers were detected by PET scans in 0.7% of all subjects, a value that is comparable to the rates found in other studies. This result suggests that additional prospective studies on PET cancer screening should be conducted in the future.

Conflict of interest statement

None declared.

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