# Incidental finding of malignancy in patients preoperatively evaluated for aneurysm wall pathology using PET/CT

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**Preoperative positron emission tomography/computed tomography (PET/CT) was performed in 26 consecutive patients considered fit for aneurysm repair. Besides information on aneurysm wall pathology, PET/CT identified 6 patients with concomitant malignancy. As a result of this coincidental finding, the operation was postponed in 2 patients and cancelled in 1. Although previous studies have shown that PET/CT might affect patient selection based on aneurysm wall inflammation, our preliminary results show a big impact on patient management as a result of the sensitivity of PET/CT for detecting malignancy. Future larger studies are warranted to investigate the effect and cost effectiveness of routine PET/CT in abdominal aortic aneurysm (AAA) patients. (J Vasc Surg 2009;49:1313-5.)**

## CASE REPORT

Because of considerable risks associated with prophylactic aneurysm repair, patient selection for surgery should include an accurate assessment of aneurysm rupture risk and the identification of co-morbid medical conditions that might limit life expectancy.[1]

Recently integrated positron emission and computed tomography (PET/CT) has been proposed as a promising technique that could provide information on aneurysm wall pathology (inflammation) and improve rupture risk prediction.[2,3] Clinically, PET/CT is used for diagnosis and follow-up of several malignancies and routine preoperative PET/CT could therefore not only provide information on aneurysm disease but also on possible co-morbid conditions limiting life expectancy in aneurysm patients. This case series describes the preliminary results of a larger prospective study conducted to evaluate aneurysm wall inflammation using PET/CT and the possible impact of routine preoperative PET/CT on patient selection for prophylactic aneurysm repair.

## MATERIALS AND METHODS

After routine preoperative assessment of pulmonary and cardiac functions, abdominal computed tomographic angiography (CTA) and chest x-ray, 26 consecutive aneurysm patients were considered fit for prophylactic surgical repair. PET/CT was performed at hospital admission, the day before surgery. The institutes' ethical review board approved the study protocol and signed informed consent was obtained from all patients. None of the patients presented with aneurysm rupture or symptoms related to pending aneurysm rupture (eg, lower back pain). However, 2 patients had a history of symptoms that could have been related to rapid aneurysm expansion or pending rupture.

PET/CT imaging after injection of fluorodeoxyglucose (FDG) was performed using an integrated PET and dual slice CT scanner (Biograph Duo, Siemens Medical Solutions, Knoxville, Tenn). Low dose CT and PET data acquisition started 1 hour after intravenous administration of 200-220 MBq FDG (Covidien, Petten, The Netherlands). PET imaging included emission images of the area between proximal femora and the base of the skull. CT scanning parameters included 40 mA and a tube voltage of 130 kV. After PET and CT data fusion, the images were analyzed by physicians experienced in combined PET and CT interpretation.

## RESULTS

Patient demographics are listed in Table I. In 6 of 26 patients (23%, 95% confidence interval 11-42%), PET/CT identified malignancy not detected by standard preoperative abdominal CTA and chest x-ray.

Five patients were diagnosed with pulmonary carcinoma, and 1 patient was diagnosed with endometrial carcinoma (Fig). The operation was cancelled in 1 patient because of extensive lymph node metastasis (Table II). For the purpose of cancer staging, endovascular aneurysm repair (EVAR) was postponed in 2 patients (48 and 24 days after PET/CT, respectively). In the remaining 3 patients, the operation was performed as scheduled, after informing the patient and consulting a pulmonary physician. The decision to proceed with the operation was made because of limited disease (no lymph node involvement) or a history of abdominal aortic aneurysm (AAA)-related symptoms (lower back pain). Two patients died of non-small cell lung cancer within 3 months after PET/CT and 1 patient died of endometrial carcinoma 9 months after PET/CT.

## DISCUSSION

After routine preoperative CTA and chest x-ray, PET/CT identified previously undiagnosed malignancy in

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**Table I.** Patient characteristics

| *Patient characteristics* | *Patients (n = 26)* |
|---|---|
| Age (years) | 71 (64-75) |
| AAA size | 58 (55-65) |
| Male | 24 (92% |
| Tumor[a] | 6 (23%) |
| CAD | 7 (27%) |
| COPD | 8 (31%) |
| CVD | 2 (8%) |
| Diabetes | 1 (4%) |
| Current smoking | 9 (35%) |
| Aspirin use | 26 (100%) |
| Statin use | 26 (100%) |
| Antihypertensive treatment | 26 (100%) |

*CAD,* History of coronary artery disease; *COPD,* chronic obstructive pulmonary disease; *CVD,* history of cerebral vascular disease; *AAA,* abdominal aortic aneurysm.
[a]After routine preoperative computed tomographic angiography (CTA) and chest x-ray, positron emission tomography/computed tomography (PET/CT) identified previously undiagnosed malignancy in 6 patients.
Continuous data is reported using median and interquartile range.

a substantial proportion of patients scheduled for aneurysm repair. Although literature on the effect of concurrent malignancy on postoperative survival in aneurysm patients is limited, the present study shows that routine preoperative PET/CT could have a big impact on patient selection for aneurysm repair.

The high prevalence of cardiovascular and pulmonary disease, together with the important impact on both operative and long-term survival following aneurysm repair calls for routine preoperative evaluation of cardiac and pulmonary functions.[4] In contrast to cardiac and pulmonary disease, little data exist on the impact of concomitant malignancy on survival after aneurysm repair.[5] The reported incidence of cancer among aneurysm patients is, however, high and estimated between 4 and 13%.[6] Moreover, Valentine et al[6] showed a higher incidence of cancer among AAA patients when compared to an age matched population, indicative for a true association between aneurysm disease and malignancy.

Although routine preoperative CTA and chest x-ray could have revealed previously undiagnosed malignancy, all patients included in this study were considered to be fit for

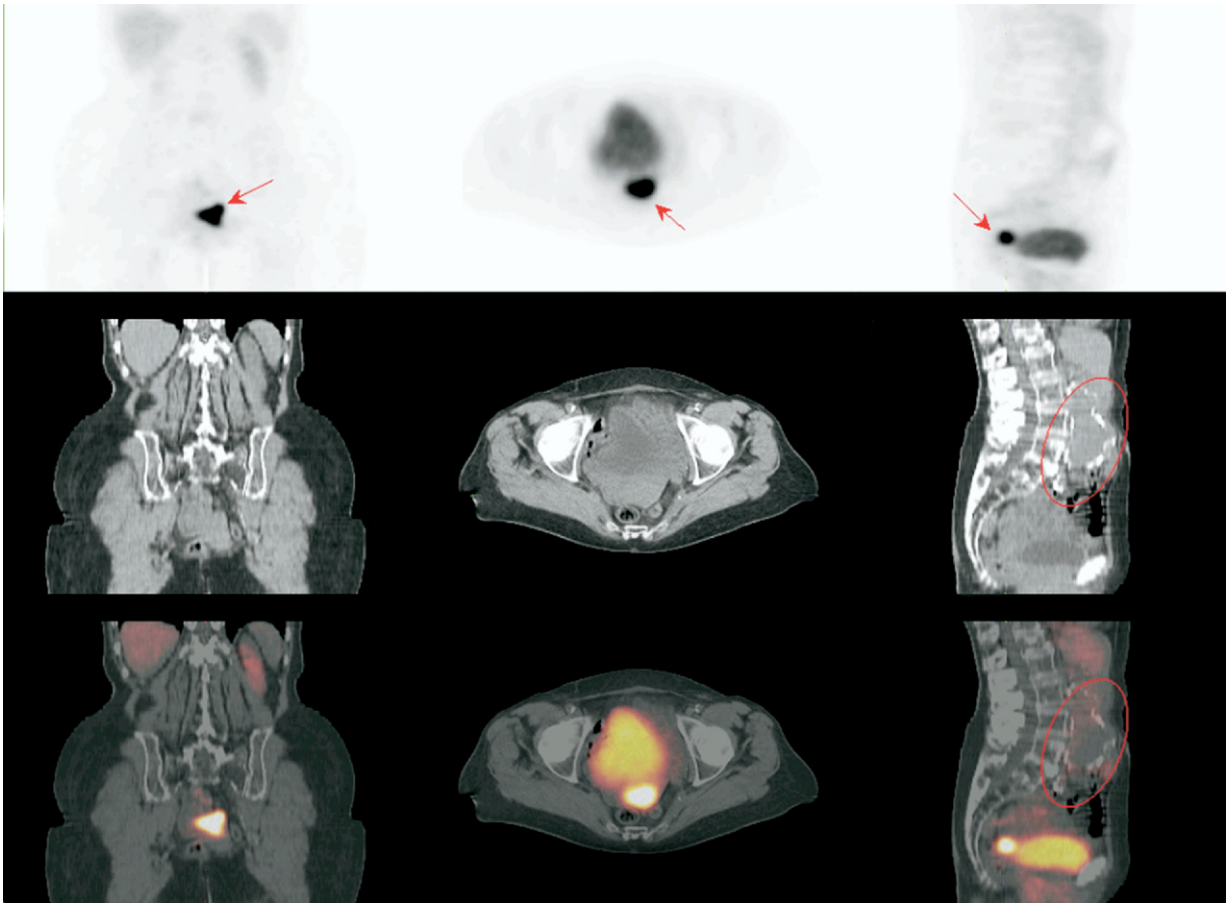

**Fig.** Incidental finding of endometrial carcinoma (*arrow*) in a patient scheduled for aneurysm repair. The top row shows the PET image. The abdominal aortic aneurysm is visible on the CT (*middle row*) and fused image (*bottom row*) on the right (*red circle*). PET, Positron emission tomography; CT, computed tomography.

**Table II.** Characteristics and outcome of patients diagnosed with malignancy

| *Patient* | *Gender* | *Age* | *AAA size (mm)* | *History of AAA related symptoms* | *PET/CT finding (FDG[1] uptake* | *Operation* | *Outcome* |
|---|---|---|---|---|---|---|---|
| 1 | M | 68 | 41 | Yes | Left lung Mediastinal lymph nodes. Ventral AAA wall. | EVAR[2] (48 days after PET/CT). Postponed for cancer staging. | Active follow-up 418 days after PET/CT. |
| 2 | F | 56 | 55 | No | Right lung. No uptake in the AAA wall | EVAR as scheduled. | Active follow-up, 252 days after PET/CT |
| 3 | F | 75 | 59 | No | Endometrium. No uptake in the AAA wall | EVAR (24 days after PET/CT). Postponed for cancer staging. | Deceased, 148 days after PET/CT |
| 4 | M | 71 | 50 | No | Right lung Mediastinal lymph nodes. No uptake in the AAA wall | EVAR cancelled | Deceased, 104 days after PET/CT |
| 5 | M | 72 | 57 | No | Left lung. No uptake in the AAA wall. | EVAR as scheduled. | Active follow-up, 49 days after PET/CT |
| 6 | M | 71 | 61 | Yes | Right lung, Mediastinal lymph nodes? No uptake in the AAA wall. | OR[3] as scheduled. | Deceased, 119 days after PET/CT |

[1]*FDG,* Fluorodeoxyglucose is radioactive labeled glucose uptake depicting increased metabolic activity in eg, inflammation, infection, cancer. FDG uptake is considered significant when the region of interest (AAA or tumor) shows higher levels of FDG than the surrounding tissue.
[2]*EVAR,* Endovascular aneurysm repair; [3]*OR,* Open repair or conventional aneurysm repair; *AAA,* abdominal aortic aneurysm; *PET/CT,* positron emission tomography/computed tomography.

surgical repair and not suspected of having cancer. The high number of patients with concurrent cancer detected by PET/CT, therefore, reflects the superiority of combined PET/CT over CT alone for the detection of malignancy.[7-9] Because of the advantages of PET/CT imaging for detecting and staging cancer, PET/CT scanners are available in most university and tertiary care hospitals. Moreover, in the past 7 years over 2500 PET/CT scanners have been installed worldwide which underscores the acceptance of PET/CT as a new standard in oncologic imaging.[10]

Possible drawbacks for the routine preoperative use of PET/CT in aneurysm patients is the associated increased exposure to radiation. In the current study, using low dose CT and FDG-PET, radiation dose is an estimated 2-4 mSv per patient. Compared to conventional CT (average 7-20 mSv) and according to the 62nd publication of the International Commission on Radiological Protection (IRCP) this is considered a minor to intermediate radiation exposure.[11] PET imaging could be performed in combination with the standard diagnostic preoperative CTA. As this will result in additional costs (approximately 1500 USD), future studies should also consider the cost effectiveness of additional PET imaging in the perspective of improved patient selection for aneurysm repair.

In conclusion, FDG-PET/CT has the potential to detect previously undiagnosed malignancy in a population of AAA patients considered fit for prophylactic aneurysm repair. Because of the high incidence of cancer among aneurysm patients and the impact of concomitant malignancy on life expectancy and timing of surgical repair, further studies are warranted to investigate the necessity and cost effectiveness of routine preoperative cancer screening in AAA patients.

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