Fluorodeoxyglucose Positron Emission Tomography and CT After Talc Pleurodesis*

Boon Han Kwek, FRCR; Suzanne L. Aquino, MD; and Alan J. Fischman, MD, PhD

Background: Talc pleurodesis is widely performed for the management of persistent pneumothorax or pleural effusion, particularly malignant effusions. However, there are very few data characterizing fluorodeoxyglucose (FDG)-positron emission tomography (PET) and CT findings after treatment.

Methods: We retrospectively evaluated the FDG-PET and CT studies of nine patients who underwent talc pleurodesis for the treatment of malignant pleural effusions or persistent air leak.

Results: FDG-PET studies were performed on average 22 months after talc pleurodesis, and the mean CT follow-up period was 25 months. There was moderate-to-intense plaque-like or focal nodular-increased FDG uptake in the pleura on PET with mean standardized uptake value of 5.4 (SEM, 1.2; range, 2.0 to 16.3). The FDG uptake was either diffuse (two patients) or focal (seven patients), and most commonly occurred in the posterior costophrenic angles (five patients), followed by the apical regions (three patients), anterior costophrenic angle (one patient), and the anterior chest wall (one patient). On CT, high-density areas of pleural thickening or nodularity (mean, 230 Hounsfield units [HU]);

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Abbreviations: FDG = fluorodeoxyglucose; HU = Hounsfield units; PET = positron emission tomography; SUV = standardized uptake value

Talc pleurodesis was first employed by Bethune1 in 1935 as a preoperative procedure to anchor the lung during lobectomy.2 Since then, talc pleurodesis has been widely employed in the management of recurrent pneumothoraces and pleural effusions, with a success rate > 90%.3-5 In 1997, Murray et al6 described increased fluorodeoxyglucose (FDG) uptake in a 66-year-old man who underwent positron emission tomography (PET) 10 months after talc pleurodesis for persistent postthoracotomy air leak. The areas of increased FDG uptake corresponded to high-density plaques on CT that were attributed to talc pleurodesis.

FDG-PET is widely employed in the management of patients with malignancy. However, increased uptake of FDG by a chronic inflammatory process in the pleura, such as talc pleurodesis, may lead to a false-positive interpretation of malignant pleural disease. To our knowledge, with the exception of the case reported by Murray et al6 there are no previous reports in the medical literature that describe the FDG-PET findings in patients following talc pleurodesis. Similarly, there is a paucity of medical literature on the CT appearance of the pleura after talc pleurodesis. The only report on the CT appearance after talc pleurodesis is by Murray et al,7 who describe pleural thickening and nodularity with high-attenuation areas. We present the FDG-PET and CT findings in our series of nine patients, all of whom underwent multiple follow-up scans after talc pleurodesis.

Materials and Methods

The study was approved by the Human Research Committee of our institution. Over a 3-year period, nine patients who underwent both talc pleurodesis and FDG-PET were identified, and a retrospective review of their clinical and radiologic records was performed. There were eight women and one man in the study group. Their mean age was 58 years (range, 26 to 73 years). All patients had a history of malignancy, five had lung carcinomas (one each in stage IA, IB, IIA, IIB, and IV), and one each had treated breast carcinoma, ovarian carcinoma (stage IV), Ewing sarcoma (metastatic), and pulmonary neuroendocrine tumor.
FDG-PET studies were obtained with either the ECAT-HR+ camera (Siemens/CTI; Knoxville, TN) or GE 4096 camera (General Electric; Milwaukee, WI). The patients fasted for at least 6 h before scanning, and blood glucose levels were measured just before injection of FDG. FDG was administered IV as a bolus, and static emission images were obtained 60 min later with multiple bed positions each of 10 min in duration. Transmission images, measured with rotating rod sources loaded with $^{68}$Ge were obtained in each bed position for attenuation correction. Image reconstruction was performed with either filter-back projection (GE 4096) or ordered-subset, expectation-maximization reconstruction algorithm (ECAT-HR+). The PET scans were retrospectively reviewed on a clinical computer reading station, and the extent, distribution, and morphology of increased FDG uptake were recorded. The degree of FDG activity was visually graded as no discernible uptake, or uptake less than, equal to, or greater than background mediastinal activity. Abnormal FDG uptake was interpreted if the uptake exceeded that of the mediastinal soft tissues. The dose, time of injection, and body weight were used to calculate standardized uptake values (SUVs) in eight patients. In addition, three patients had FDG-PET studies performed prior to talc pleurodesis, which were compared with the pretreatment images.

CT scans were obtained with GE HighSpeed or LightSpeed scanners (General Electric). Scans were obtained at 5-mm slice interval during a single breath-hold. Seven patients underwent CT scans both with and without IV contrast (100 mL of ioxilan, 300 mg of iodine per milliliter, at an injection rate of 2 mL/s), while two patients only had scans performed with IV contrast. The CT scans were retrospectively reviewed on mediastinal windows settings (window width, 350 Hounsfield units [HU]; window level, 40 HU) on a picture archiving and communication system monitor. The extent, distribution, size, morphology, and density of the pleural findings were recorded as well as the presence of pleural effusion. In addition, six patients underwent CT scans before talc pleurodesis that were compared with the posttreatment images.

## Results

On average, the patients in our study underwent their first FDG-PET study 22 months after talc pleurodesis (range, 10 days to 71 months) [*Table 1*]. All the FDG-PET studies showed increased pleural uptake, with the sole exception of a patient who underwent FDG-PET examination 10 days after surgery. For this patient, a subsequent FDG-PET scan obtained 3 months later showed intense increased FDG uptake in the pleura. The area of increased uptake had a mean SUV of 5.4 (SEM, 1.2; range, 2.0 to 16.3).

The areas of increased FDG uptake in the pleura were diffuse in two patients (Fig 1). In the other seven patients, areas of increased FDG uptake were multifocal and most commonly in the posterior costophrenic angles (five patients) and apices (three patients). In patients with focal areas of increased uptake, the most common morphology was plaque-like areas (five patients), combined with rounded nodular areas of increased uptake in two of these five patients. The remaining two patients with focally increased uptake showed a rounded nodular morphology.

The three patients who underwent FDG-PET scans performed prior to talc pleurodesis did not show any abnormal uptake of FDG in the pleura. All patients underwent multiple CT scans at least 6 months apart. The first posttherapy CT was performed on average 13.2 months (range, 2 weeks to 75 months) after pleurodesis. The extent and distribution of increased FDG uptake corresponded to areas of high-attenuation pleural thickening on CT. These areas of pleural thickening were on average 1.2 cm thick (range, 0.6 to 2.3 cm) and measured an average of 7.1 cm (range, 4.2 to 8.2 cm) in the longest dimension. The nodules in four patients had an average diameter of 1.5 cm (range, 0.4 to 3.1 cm). The mean density measurement of the pleural thickening was 230 HU (range, 140 to 380 HU). Seven patients underwent CT scans with and without IV contrast, and there was no evidence of increased enhancement in the areas of pleural thickening after contrast administration (Fig 2). The areas of pleural thickening from talc remained stable on subsequent CT scans obtained over an average follow-up period of 25 months (range, 9 to 48 months) in eight patients with no evidence of pleural malignancy. There were no loculated pleural fluid collections in any of the patients, although a small free effusion was noted in one patient. Three of the patients received pleurodesis for pleural effusions; two patients had a tumor found by cytology (ovarian and lung carcinoma). These two patients were free of recurrent disease by CT at 4 years and 7 years after pleurodesis, and 40 months and 18 months after initial PET scan, respectively. The other patient, with

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*NA = not available.

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*Information retrieved from [Chest Journal](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/22010/).*
effusion cytology findings negative for tumor, had no evidence of new pleural disease 11 months after pleurodesis and initial PET scan.

In the six patients who received talc pleurodesis for postthoracotomy air leak, five patients were free of new pleural disease on follow-up surveillance CT scans 9 to 48 months (mean, 25 months) after initial the FDG-PET scan. In one patient, who was treated for lung cancer and underwent right talc pleurodesis 2 years previously, a new area of increased FDG uptake (SUV, 2.0) in the contralateral left thorax developed that was not present in a PET scan performed 6 months earlier (Fig 3). Corresponding CT scan showed a mass of soft-tissue density with heterogeneous enhancement that was not present in an earlier CT scan, consistent with tumor recurrence. However, the areas of pleural uptake due to talc granulomas in the right thorax (SUV, 2.5) remained stable on follow-up CT with no evidence of malignancy.

**DISCUSSION**

Bethune described the anatomic changes in the pleura following talc pleurodesis in animal studies. He observed that despite uniform scattering of talc powder over the pleura during thoracotomy, the powder subsequently accumulated into well-demarcated nodules. In 1969, Jones described the postmortem findings in seven patients who received talc pleurodesis: “During the first two weeks the
pleura was covered with a hemorrhagic fibrin purulent exudate. By the third week, the response was more collagenous with areas of necrosis, and talc granulomata were present. At 6 months there was much dense pleural fibrosis. Sparse talc particles were seen under polarized light."

Two case reports by Ahmed and Shrager and Williams et al. described a granulomatous giant cell reaction in the pleura that surrounded the talc crystals on histopathology. Many studies have shown that pleural malignancy yields increased FDG-PET uptake in the pleural space. With the sole exception of a case report by Murray et al., there is no other report in the medical literature describing similar findings with talc pleurodesis. Reports of false positive FDG-PET findings for pleural malignancy include asbestos reaction, pleurisy, pleural effusion secondary to inflammatory process, recent surgery, or radiotherapy.

In our series, two patients received talc pleurodesis for treatment of documented malignant pleural effusions. Both were free of recurrence in the pleura by CT, 18 months and 40 months after the initial PET scan, respectively. Six of the nine patients in our series received talc pleurodesis for a persistent air leak following thoracic surgery for malignancy. Five of these patients have been free of pleural tumor on subsequent follow-up clinical and radiologic studies 9 to 48 months after the initial PET scan. Metastasis in the pleura on follow-up imaging was seen in one patient. This appeared as a new area of increased FDG uptake in the contralateral thorax and correlated with a new mass on CT (60 HU) [Fig 3].

Thus, in patients treated with talc pleurodesis who have areas of increased FDG uptake on PET, a review of CT scans is necessary to correlate the areas of talc deposit to regions of increased FDG uptake. In addition, it is essential to monitor stability of foci of increased activity on subsequent PET scans to detect new areas of increased uptake that should raise a concern for new pleural metastasis.

**Conclusion**

Talc deposits in the pleura produce areas of increased uptake on FDG-PET that correspond with areas of high-density pleural thickening on CT. It is important to correlate these PET findings with CT imaging and clinical history to distinguish this benign inflammatory process from malignancy. Alternatively, in patients who have undergone talc pleurodesis, it is important to carefully identify and follow up these associated inflammatory foci in order to detect new pleural metastases.

**REFERENCES**


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**Figure 3.** A 73-year-old women who underwent treatment for lung cancer with talc pleurodesis 2 years earlier. **Top,** A: Baseline PET scan shows stable foci of increased FDG uptake in the right pleural space (arrow) consistent with talc deposits. **Middle,** B: Follow-up PET 6 months later shows a new area of increased uptake (arrow) in the left thorax adjacent to the middle mediastinum. **Bottom,** C: Corresponding CT scan shows a soft-tissue mass (arrow) with heterogeneous enhancement in the prevascular space, left of the ascending aorta consistent with tumor recurrence.
8 Jones GR. Treatment of recurrent malignant pleural effusion by iodized talc pleurodesis. Thorax 1969; 24:69–73