FDG-PET Evaluation of Retroperitoneal Metastases of Testicular Cancer Before and After Chemotherapy

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We describe a patient whose primary tumor was a testicular teratocarcinoma predominantly composed of embryonal carcinoma. Before chemotherapy, the retroperitoneal metastases demonstrated heterogeneous, increased glucose metabolism as measured by 2-[^{18}F]fluoro-2-deoxy-D-glucose and PET (FDG-PET). After chemotherapy, FDG uptake was reduced to normal values despite increased tumor volume. Histology revealed a pure mature teratoma. This observation suggests that further studies are needed to determine whether tumor differentiation of testicular teratocarcinoma metastases can be assessed by measuring glucose metabolism.

Key Words: testicular neoplasms; neoplasm chemotherapy; teratoma; PET; fluorine-18-FDG

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About 40% of patients with nonseminomatous testicular cancer present with retroperitoneal metastases at diagnosis. These patients are referred for chemotherapy depending on the tumor's clinical stage. In some patients, retroperitoneal metastases size remains unchanged, or the retroperitoneal tumor masses grow despite chemotherapy. We report on the utility of using FDG-PET to measure glucose metabolism in a case of nonseminomatous testicular carcinoma.

CASE REPORT

We studied a 23-yr-old man who presented with an enlarged right testis suspicious for a malignant tumor. In addition, a palpable and painful abdominal mass was found. Serum concentrations of α-fetoprotein and β-HCG were 494 ng/ml (normal < 7 ng/ml) and 917 ng/ml (normal < 5 ng/ml), respectively. Inguinal orchiectomy of the right testis was performed. Histopathological examination revealed a teratocarcinoma predominantly composed of embryonal carcinoma and only small foci of a mature teratoma (Fig. 1A, B). Abdominal CT scans, contrasted intravenously and orally, were acquired as 10-mm slices. The CT scans demonstrated a retroperitoneal mass with heterogeneous x-ray absorption extending from the renal vessels to the aortic bifurcation ("bulky disease," size of 12 × 10 × 100 cm; Fig. 2A). Lung metastases were not detected on planar radiographs and chest CT scans. FDG-PET of the abdominal region was performed.

An intravenous bolus injection of 370 MBq [^{18}F]FDG was administered in the fasting state. The abdominal region was scanned dynamically from time of injection for 75 min with a PET scanner with an effective resolution of 7 mm. Transversal slices were reconstructed by filtered backprojection and scaled in DUR (differential uptake ratio; DUR = tissue activity/[injected activity × body weight]).

FDG-PET demonstrated heterogeneous FDG uptake in the retroperitoneal mass, revealing regions of increased FDG uptake up to 11-DUR and regions with low FDG values below 1-DUR (Fig. 2B).

Three cycles of polychemotherapy were administered (PEB-scheme: cisplatin, etoposide and bleomycin). After chemotherapy, the tumor markers α-fetoprotein and β-HCG were within the normal range. Restaging examinations showed that the overall size of the retroperitoneal tumor mass was increased as measured on CT scans (size 15 × 11 × 111 cm). Parts of the retroperitoneal tumor were shrunken and other parts had grown during chemotherapy (Fig. 2C). Those parts of the tumor that had grown despite chemotherapy were suspicious for residual viable malignant tissue. In contrast, FDG-PET of the abdomen demonstrated complete normalization of FDG uptake (≤2DUR) and no foci of increased glucose metabolism (Fig. 2D). The tumor parts that had shrunken after chemotherapy had increased FDG uptake before chemotherapy. Regions of the retroperitoneal mass that had grown despite chemotherapy did not show any increased FDG uptake before and after chemotherapy.

A radical retroperitoneal lymph node dissection was performed. Histopathological examination revealed a mature teratoma with large cystic areas and without any foci of embryonal carcinoma cells (Figs. 1C, D).

DISCUSSION

Thirty-eight percent of all patients with testicular cancer present with para-aortal metastases at time of diagnosis (*1*). CT of the abdomen is commonly used for staging examinations of para-aortal lymph nodes. Patients with metastases undergo polychemotherapy. Restaging after chemotherapy is based on the CT results and tumor marker measurements. In patients with retroperitoneal metastases, retroperitoneal lymph node dissection is then performed if the serum levels of tumor markers decrease to normal and the metastases disappear or shrink significantly (*2*). If retroperitoneal tumor masses remain unchanged after chemotherapy or even grow despite chemotherapy, the decision for either lymph node dissection or additional courses of chemotherapy (second-line chemotherapy) can be extremely difficult.

In a population of 360 patients with nonseminomatous germ-cell tumors, 14 patients had retroperitoneal masses that had enlarged despite chemotherapy (*3*). It would be useful to find a potent diagnostic tool that could differentiate between residual low differentiated metastases requiring additional chemotherapy and mature teratomas requiring surgical intervention. Immunoscintigraphy with monoclonal antibodies against

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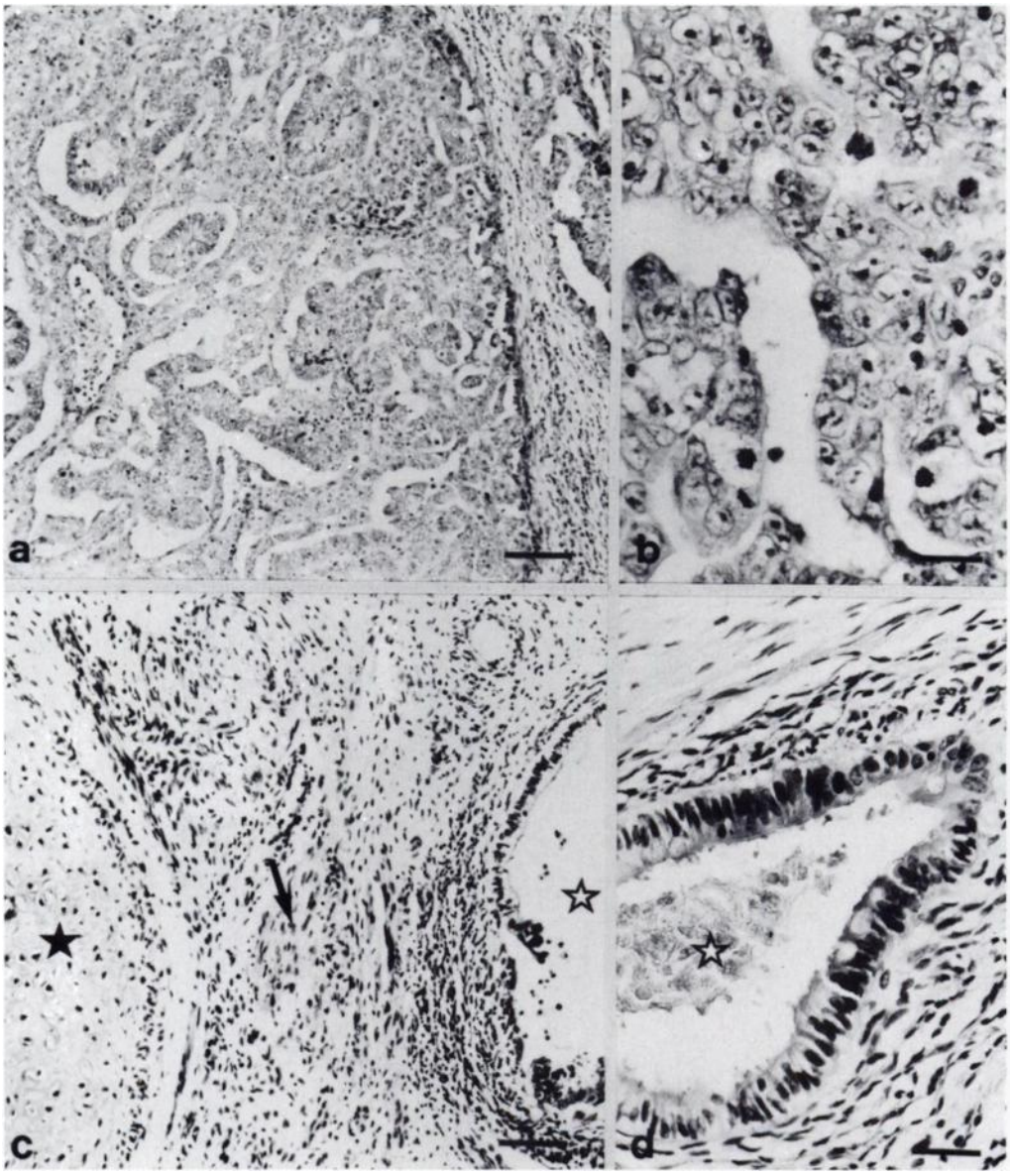

FIGURE 1. Teratocarcinoma of the testis predominantly composed of embryonal carcinoma (a) is shown in more detail in (b). (c) Mature teratoma with chondroid tissue (★), bundles of smooth muscle (arrow) and a small bronchus-like structure (☆) is shown in more detail in (d). H&E staining: a,c: bar = 200 μm; b: bar = 50 μm; d: bar = 80 μm).

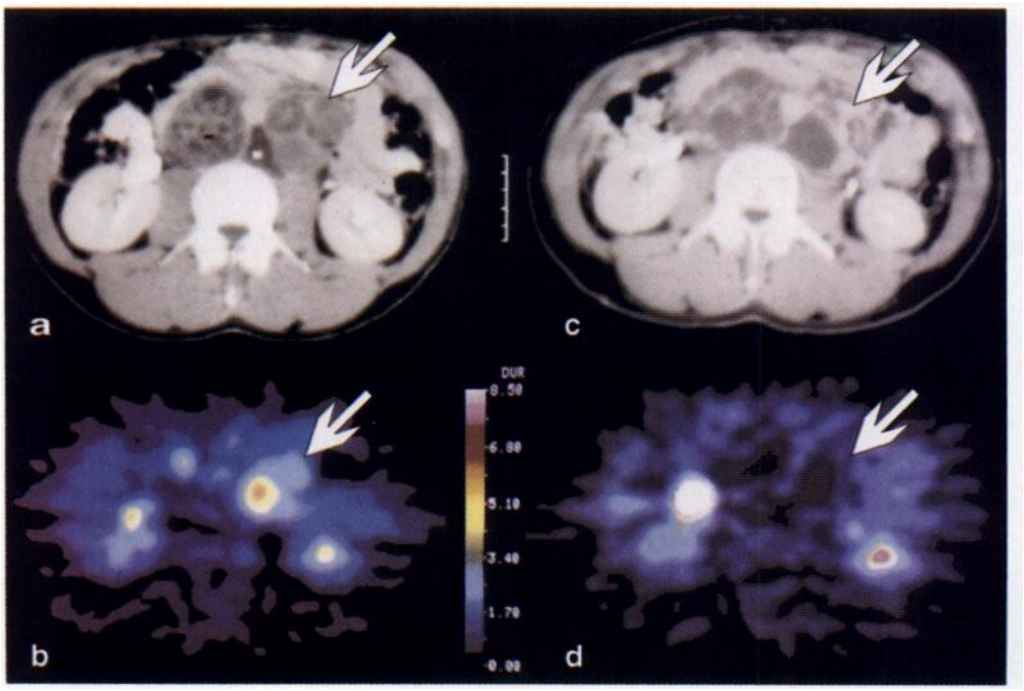

FIGURE 2. Before chemotherapy, the retroperitoneal tumor mass shows heterogeneous x-ray absorption on the CT scan (a) and heterogeneous accumulation of FDG with FDG uptake values between 1 and 8 DUR in the corresponding transversal section of FDG-PET (b). The dilated renal pelvis of the right kidney is clearly seen. Following chemotherapy, tumor size is unchanged (c). Those parts of the tumor mass with increased FDG uptake before chemotherapy demonstrate complete normalization of glucose metabolism (arrows) (d).

α-fetoprotein and β-HCG is currently not available in Germany due to legal restrictions and has not been studied for its diagnostic potential in a larger population of patients with testicular cancers. Immunoscintigraphy with β-HCG-antibodies detected testicular carcinomas in three out of five patients (two false-negatives) (*4*). Only two patients were studied using immunoscintigraphy with α-fetoprotein antibodies; both scans were false-negative (*5*).

In our patient, the growth of the retroperitoneal mass in contrast to the normalization of tumor marker levels were key factors in determining appropriate treatment regimens. The additional information about the metabolic behavior of the retroperitoneal mass as measured by FDG-PET was also important. FDG-PET helped to detect retroperitoneal tumor tissue as viable solid metastases with high FDG uptake, tissue with low FDG accumulation, or cysts or necrosis without FDG accumulation.

We have observed two additional patients with nonseminomatous testicular cancers who had small residual retroperitoneal masses (3 and 1.5 cm in diameter) after chemotherapy. These two patients also demonstrated, postchemotherapy, normalization of FDG accumulation in these masses which were histologically proven to be mature teratomas (unpublished results).

CONCLUSION

These results demonstrate that tumor metabolism as determined by FDG-PET can be significantly suppressed after chemotherapy without reductions in tumor size. This observation could be interpreted as a response of the low differentiated tumor parts to chemotherapy and a selection of the higher differentiated tumor parts. The appropriate therapy of testicular cancer with retroperitoneal metastases in this situation is complete resection of the metastatic tumor rather than additional chemotherapy (*3*). We therefore propose to examine the usefulness of measuring glucose metabolism in these tumors to assess regional tumor differentiation.

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Incidence of Subclavian Vein Thrombosis Detected During First-Pass Phase of Radionuclide Angiocardiogram

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A 79-yr-old woman with asymptomatic subclavian vein thrombosis associated with transvenous pacemaker electrode and congestive heart failure is reported. The subclavian thrombosis was discovered accidentally from the first-pass radionuclide angiogram that is routinely performed with the intravenous bolus injection of the radiopharmaceutical for a gated blood-pool study. It demonstrated venous obstruction at the level of the subclavian vein and abnormal collateral circulation over the chest wall consistent with subclavian thrombosis. This case report and literature review demonstrates the importance of performing first-pass radionuclide cardioangiography routinely before multigated blood-pool studies in patients with pacemakers.

Key Words: vein thrombosis; transvenous pacemaker; first-pass radionuclide angiogram

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The current trend in nuclear medicine practice is to only perform radionuclide multigated (MUGA) studies without first-pass radionuclide angiography. In patients with pacemakers, we recommend the first-pass study to be part of all MUGA studies because of the possibility of detecting asymptomatic thrombosis of the subclavian or innominate veins which will not be detected in the delayed gated images. We report the case of a 79-yr-old woman who had a pacemaker because of sick sinus syndrome and syncope. Dyspnea and asymptomatic subclavian thrombosis was incidentally detected by first-pass radionuclide angiogram. If the multigated images were acquired alone without the first-pass part of the radionuclide angioventriculography, those symptoms would have been overlooked.

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CASE REPORT

A 79-yr-old woman was admitted to the hospital for the evaluation of increasing shortness of breath and evidence of congestive heart failure. The patient's past medical history was significant for coronary artery disease with previous MI, congestive heart failure, intermittent atrial fibrillation, COPD and chronic left DVT with recurrent pulmonary embolism. The patient has chronic dyspnea and uses home oxygen therapy.

A permanent transvenous pacemaker was inserted 10 yr previously because of syncope and sick sinus syndrome. The pacemaker was a Pacesetter DVI pulse generator. The ventricular lead was of