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normalization of FDG accumulation in these masses which were histologically proven to be mature teratomas (unpublished results).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

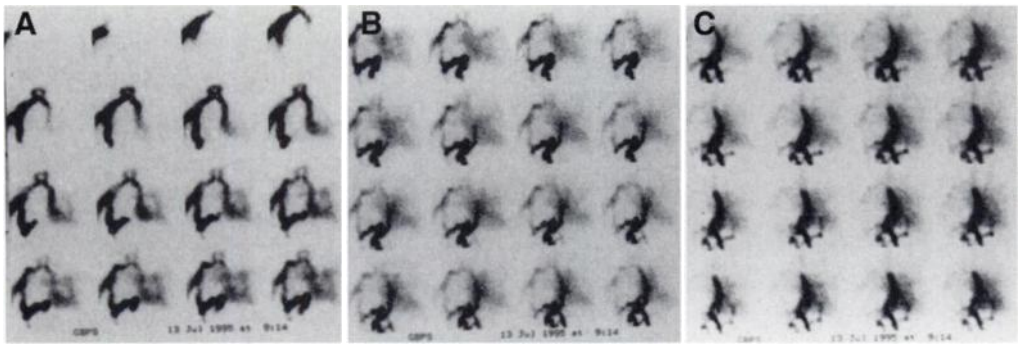

FIGURE 1. First-pass radionuclide cardiac angiogram every second after intravenous injection 740 MBq of radiopharmaceutical showing arrival of the bolus to the right axillary and subclavian veins, nonvisualization of superior vena cava, visualization of collaterals over anterior chest and upper abdominal wall with delayed arrival of activity to the inferior vena cava, lungs and left ventricle.

silicone fined FAST-PASS lead and the atrial lead was a medtronic screw-in atrial lead (model 69575–58) with polyurethane insulation. A radionuclide multigated study was requested to evaluate ventricular function. After 3.4 mg of stannous pyrophosphate in saline were administered intravenously, the first-pass radionuclide angiogram was acquired after intravenous bolus injection of 20 mCi (740 MBq) [^{99m}Tc]pertechnetate for in vivo labeling of erythrocytes in the right arm. Dynamic images were acquired to the region of the heart and thoracic outlet every second for a total 60 sec.

This study demonstrates venous obstruction from the right subclavian vein and venous collaterals over the thoracic wall connecting to intercostal veins that drained to the upper abdomen and to the azygos vein to reach the inferior vena cava (Fig. 1). This collateral pattern was suggestive of thrombotic occlusion of subclavian vein extending to the axillary vein rather than a short segmental obstruction involving only the subclavian vein. The gated blood-pool study showed moderately dilated right atrium and right ventricle with mild dilatation of the left ventricle. The regional wall motion evaluation demonstrated akinesis of mid-to-distal part of both anterior and inferior wall and proximal septum together with hypokinesis of the distal septum. The calculated LVEF was 27%. The subclavian vein thrombosis and the collateral circulation were not demonstrated on the regular multigated blood-pool images (Fig. 2).

DISCUSSION

The transvenous approach to place pacemaker leads is the most common method of permanent cardiac pacing. There are different classifications of pacemakers according to duration (temporary compared with permanent), insulation material (silicone, polyurethane, polyethylene) and number of leads (single or dual chamber pacing).

The incidence and frequency of thrombotic complications in patients with pacemakers are infrequently discussed (*1–7*). The pathogenesis of venous thrombosis is probably multifactorial. Early pacemaker-induced venous thrombosis may be due to extension of thrombus from ligated veins, local vascular injury of the entry site, endothelial damage distal to the entry site and an underlying hypercoagulable state. Late pacemaker-induced venous thrombosis may be due to foreign body reaction, propagation and extension of thrombus and thrombus superimposed on fibrous stenosis (*7*).

FIGURE 2. Multigated end diastolic and systolic left anterior oblique projection images showing normal appearance. No trace of the collaterals over the chest wall is seen in these delayed images.

The diagnosis of pacemaker-induced venous thrombosis may be apparent on physical examination and confirmed with diagnostic imaging. Depending on the extent of venous obstruction, time course of the obstruction and degree of collateral vessel of motion, the physical signs and symptoms may vary from absent (in the case of slow obstruction with adequate collaterals) to the full-blown superior vena cava obstruction syndrome (in the case of acute SVC occlusion). Although most patients are asymptomatic, a thorough and meticulous physical examination and history taking is important in suggesting venous thrombosis. The examination may reveal the clinical signs of upper extremity edema, venous prominence and features of the superior vena cava syndrome, and past medical history may reveal multiple pulmonary emboli.

Diagnostic imaging modalities include contrast venography, radionuclide venography, digital subtraction venography and duplex ultrasonography (*9,10*). The venographic studies (contrast, radionuclide, digital subtraction) are indicated to establish the diagnosis once clinical signs and/or symptoms suggest the presence of thrombosis.

The detection of asymptomatic cases of venous thrombosis is important because it enables establishing the diagnosis and provides baseline for future follow-up regarding progression of obstruction. Moreover, the affected veins will be known and will not be used for drug application, central venous pressure monitoring or any other diagnostic or therapeutic procedure.

Patients with permanent transvenous pacemakers that undergo gated blood-pool studies for evaluation of their ventricular function can be simultaneously screened for pacemaker-induced venous thrombosis, if first-pass radionuclide angiogram is performed as the initial part of the study. This approach will provide extra clinical information without causing extra radiation burden to patients and personnel. Additionally, the intravenous bolus injection should be performed on the side of pacemaker insertion to detect venous thrombosis involving subclavian vein with or without axillary vein extension. On the other hand, superior caval vein thrombosis will be detected whether the injection is performed on the side of pacemaker insertion or on the contralateral side.

CONCLUSION

In view of the high incidence of pacemaker-lead-induced venous thrombosis [30%–45% of patients according to Sittell and Heyes (*7*)] and the absence of symptoms in most cases of DVT, we recommend the utilization of a first-pass radionuclide

angiogram on a routine basis as part of gated blood-pool studies in patients with pacemakers.

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Volume-Dependent Pulmonary Aspiration of a Swallowed Radionuclide Bolus

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The radionuclide salivagram was introduced as a simple physiologic technique to document the aspiration of saliva in patients with chronic lung disease. We previously reported positive studies to be prevalent in patients with neuromuscular incoordination, as with cerebral palsy, or after surgery involving the upper airway. Many patients referred for a salivagram, however, have an apparent intact swallowing mechanism and are better challenged with a tagged bolus.

Key Words: aspiration; salivagram; swallowed bolus

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The aspiration of oral secretions is recognized as a source of recurrent lung infections. This is most likely to occur in patients with abnormal laryngeal closure (*1*). The salivagram was introduced to document the aspiration of saliva in patients with chronic lung infections, many of whom are not receiving oral feeding (*2*). Additionally, other studies have documented its efficacy (*3,4*). With the reported success of this study, patients are being referred because of suspected aspiration for causes other than abnormal laryngeal closure, such as with severe gastroesophageal reflux. It appears that patients with apparently intact swallowing mechanisms, in whom the salivagram is negative, may well aspirate when presented with a bolus.

CASE REPORT

A 7-yr-old girl was referred from an outside hospital for respiratory failure. She was a 26-wk premature infant who required assisted ventilation for bronchopulmonary dysplasia. At the time, she suffered severe retinopathy of prematurity and was legally blind. An intraventricular hemorrhage in the neonatal period resulted in a seizure disorder. Previously, she had a Nissen fundoplication for severe gastroesophageal reflux. Her chronic lung disease has been treated with anti-asthma medication, and until about 4 mo before admission she received mechanical ventilation through a tracheostomy tube while at home. During the 5 days before admission, she developed an upper respiratory tract infection associated with increasingly difficult breathing, which failed to respond to her usual medication. She was admitted to the hospital in respiratory failure and required intubation and mechanical ventilation.

A respiratory syncytial virus infection was diagnosed. A gastrostomy tube was placed for feeding. With medication, she slowly improved. While taking sips of fluid, orally, it was noted that some appeared in the tracheostomy tube. This prompted a workup to document aspiration. A salivagram was ordered. The patient lay supine on the table with a low-energy, all-purpose collimator positioned posteriorly. A drop, approximately 100 μl in volume containing 11.1 MBq (300 μCi) ^{99m}Tc-sulfur colloid, was placed on the tongue. With the mouth, thorax and stomach in the field of view, sequential 30-sec images in 128 × 128 matrix were acquired for 60 min. There was normal transit into the stomach without evidence of pulmonary aspiration (Fig. 1). Since this patient did not clinically appear to have difficulty handling the normal production of saliva, an aspiration study with a swallowed bolus was sug-

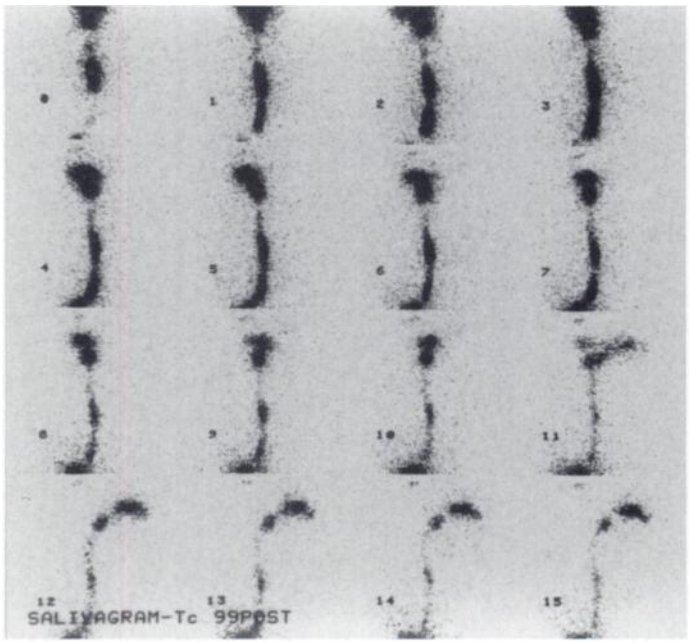

FIGURE 1. Images from the salivagram showing transit of the activity into the stomach without evidence of aspiration.

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