Tc-99m MDP, thallium-201 chloride and Tc-99m MAG3 renal uptake in subacute and chronic radiation nephritis compared

Berna DEGIRMENCİ,* Kamer UYSAL,** Recep BEKİŞ,* Rıza CETİNGOZ,*** Gamze Capa KAYA* and Hatice DURAK*

Departments of *Nuclear Medicine, **Pediatrics and ***Radiation Oncology, Dokuz Eylul University, Medical School, Izmir, Turkey

The authors present a comparison of the findings for thallium-201 (T1-201), Tc-99m MAG3 and Tc-99m MDP in subacute and chronic radiation nephritis in a 9-yr-old boy who was treated by radiation therapy for alveolar rhabdomyosarcoma of the left chest wall by a radiation port that partially included the left kidney. TI-201 imaging three and six months later showed a cortical defect in the left kidney due to radiation nephritis. Tc-99m MDP scan showed increased uptake on both occasions, but more marked in the subacute period than in the chronic period. Tc-99m MAG3 showed decreased concentration and increased cortical retention three months later. Six months after the radiation therapy, a cortical defect corresponding to the cortical area that showed increased parenchymal retention was more prominent in the Tc-99m MAG3 scan.

In the present case, Tc-99m MDP, TI-201 and Tc-99m MAG3 findings may provide useful information for understanding pathophysiological damage in the kidney after radiation.

Key words: radiation nephritis, Tc-99m MDP, Tc-99m MAG3, TI-201

INTRODUCTION

Increased Tc-99m MDP in kidneys after radiotherapy has been reported,1-4 but to our knowledge, changes in thallium-201 chloride (TI-201) and Tc-99m MAG3 uptake in the kidneys after radiotherapy have not been previously published. We are presenting the findings of Tc-99m MDP, TI-201 and Tc-99m MAG3 uptake in subacute and chronic radiation nephritis in a 9-yr-old boy who was treated by radiation therapy for alveolar rhabdomyosarcoma of the left thoracic wall.

CASE REPORT

A 9-yr-old boy had surgical resection for alveolar rhabdomyosarcoma that involved the 6, 7 and 8th ribs on the left side. The surgery was followed by radiotherapy of the chest wall that involved the left upper quadrant of the abdomen and chemotherapy. The radiation field included the upper part of the left kidney. Three months after the end of the therapy, TI-201 tumor localization and Tc-99m MDP bone scan studies were requested for evaluation of residual tumor tissue and bony metastasis. A Tc-99m MAG3 study was subsequently requested for evaluation of renal function.

TI-201 tumor imaging was performed 20 minutes and 2 hours after 74 MBq (2 mCi) of TI-201 injection. Bone scan was performed after the TI-201 study with 370 MBq (10 mCi) of Tc-99m MDP. Anterior and posterior whole body and planar images were obtained for both TI-201 and bone scan. TI-201 imaging showed decreased uptake on the lateral upper part of the left renal cortex corresponding to the portions of the left kidney that were included in the radiation field (Fig. 1A). The bone scan showed markedly increased Tc-99m MDP uptake in the same region (Fig. 1B). This was thought to be due to radiation nephritis. One week later a Tc-99m MAG3 scan was performed to evaluate the left renal function within a plan of radiation nephritis. It showed a regional decreased concentration and increased cortical retention corresponding
Three months after radiotherapy, TI-201 imaging showed decreased uptake on the lateral upper site of renal cortex corresponding to the portions of the left kidney that was included within radiation field (arrowhead) (A). Marked increased Tc-99m MDP uptake was found on the same area (arrows) (B). Six months after radiotherapy, TI-201 imaging shows decreased uptake on the same area as similar to previous scan (arrow) (C), although slightly increased Tc-99m MDP uptake remained on the lateral upper left kidney (arrows) (D).

DISCUSSION

Increased Tc-99m MDP uptake in kidneys soon after radiotherapy has been reported. This may be due to damage to renal tubular cells after radiotherapy. The abnormal intracellular flux of ionic calcium induced by ischemia or other damage to cell membrane integrity has been clearly shown to be a preliminary factor in the increased uptake of Tc-99m phosphates by injured cells. Tc-99m pyrophosphate localizes in intracellular calcium.

Fig. 1 Three months after radiotherapy, TI-201 imaging showed decreased uptake on the lateral upper site of renal cortex corresponding to the portions of the left kidney that was included within radiation field (arrowhead) (A). Marked increased Tc-99m MDP uptake was found on the same area (arrows) (B). Six months after radiotherapy, TI-201 imaging shows decreased uptake on the same area as similar to previous scan (arrow) (C), although slightly increased Tc-99m MDP uptake remained on the lateral upper left kidney (arrows) (D).

Fig. 2 Tc-99m MAG3 study that was obtained three months after radiotherapy. There is increased cortical retention on the area within the radiation field at dynamic renogram (arrow).

Fig. 3 Six months after radiotherapy, there is a more prominent cortical defect corresponding to the area of the left kidney affected from radiation field due to cortical scar at the concentration phase of Tc-99m MAG3 scintigraphy (arrow). The slight activity retention is seen in the adjacent calyces to cortical scar.