LOCALIZED KIDNEY UPTAKE OF BONE IMAGING AGENT FOLLOWING RENAL IRRADIATION

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ABSTRACT

A 14 years old girl, with documented Ewing's sarcoma, was treated by both chemotherapy and surgery. An initial bone scan (TC-99m-MDP) did not reveal a renal lesion. However, following therapeutic irradiation, there was retention of the bone imaging agent in a portion of the kidney that had been included in the radiation field. This reflected the effects of radiation related parenchymal alteration rather than retention of the bone imaging agent due to outflow tract obstruction, or to the presence of tumor.

INTRODUCTION

The potential for renal injury, following tumor irradiation in which the kidneys have been included in the treatment portal, has been recognized (1-3). Early and late effects have been related to factors such as dose, renal volume irradiated, and the timing of dose delivery. Radiation planning is carefully carried out, to exclude as much renal tissue as possible from the treatment portal. We describe a case in which bone imaging incidentally detected a renal change after therapeutic irradiation.

CASE REPORT

A 14 years old female presented to her physician with the chief complaint of left sided back pain. Subsequent workup revealed a left postero-lateral chest wall mass. Biopsy revealed that the tumor contained small bluish colored cells that were classified as Ewing's sarcoma.

The patient underwent chemotherapy, followed by surgery 3 months later. At surgery, the mass was resected as well as portions of left ribs 7, 8 and 9. Surgery was followed by 3 rounds of radiation therapy delivered in a period of 90 days. Two courses of photons and one of electrons were used to achieve 1500 cGy to the left hemithorax (Figure 1). There was also a dose of 2880 cGy to the tumor bed in one orientation and 720 cGy in a second orientation. The patient then underwent multiple additional rounds of chemotherapy.

Imaging studies to follow the patient included chest radiographs, whole body bone scans and body computed tomographs. At five months after completion of radiation therapy, a follow up bone scan was obtained (right side of Figure 2; the initial bone scan is shown in the left hand side of the figure). Noted was diffuse activity in the left midthorax and concentration of radiotracer in the upper pole of the left kidney. Because of this unusual appearance of the left kidney, an abdominal CT was performed to examine for a mass or hydronephrosis. However, no abnormalities were noted on the CT images (Figure 3).

Upon reexamination of the renal appearance on the bone scan, the quite straight lower margin of radionuclide uptake gave a clue of the possibility of a radiation portal effect. The planning radiograph, prior to therapeutic irradiation, demonstrated inclusion of the upper pole of the left kidney (Figure 1).

DISCUSSION

At therapeutic doses of irradiation, "radiation nephritis" can affect the kidneys. This has been reported to occur at exposures as low as 2300 cGy delivered over a period of 5 weeks (4,5). Two subtypes of radiation nephritis have been described, depending on the time of initial symptom manifestation (but recall that in our case, there was no renal symptomatology). Acute radiation nephritis has symptoms presenting between 3 and 18 months after irradiation. There can be included elevated serum BUN, albuminuria, urine casts and hypertension (4,5). Chronic radiation nephritis symptoms occur after 18 months and include benign or malignant hypertension, proteinuria and progressive renal inadequacy (1,2,4).

Despite efforts to exclude as much normal renal parenchyma from radiation treatment portals as possible, it is not surprising to find evidence, by imaging modalities, of renal involvement in patients who are asymptomatic. Our patient was 5 months out from her radiotherapy and there was no clinical suspicion of any renal damage.

Detection of bone agent uptake in the left kidney was an unexpected finding. Common differential possibilities include tumor and the obstruction to urine outflow. However, an abdominal CT examination failed to show either of these findings. A key was in reexamining the bone scan and noting the straight edge to the region in which accumulation occurred. Comparison to the treatment ports showed inclusion of the small portion of the left kidney that revealed accumulation of the bone imaging radiotracer. Literature review revealed other reports in which renal radiation-induced changes were incidentally detected on bone imaging (5-7).

If a sufficient region of radiation related renal damage has been induced, scintigrahy and CT imaging can be useful in detection (8,9). Functional renal imaging may be more sensitive than intravenous pyelography in detecting segmental renal dysfunction related to radiation injury (and perhaps in following any recovery). In more extensive renal radiation insult, progression of the problem (up to non-function) can be demonstrated (10).

With CT, parenchymal density differences can usually be detected and this can be enhanced by use of contrast agents (8). CT images of the left kidney were reexamined, but failed to show significant differences between the Hounsfield absorption numbers between the non-irraaiated and irradiated parts of the kidney (probably owing to insufficient damage at the time of the examination). It appears paradoxical to find increased accumulation of the bone imaging agent in the irradiation region, as compared with the usual decrease in uptake of functional agents. Likely due to damage to capillaries, tubules and glomeruli, iodinated contrast agents and rediopharmaceutical kidney agents have less uptake in damaged renal sites (11). Accumulation of bone imaging agents in regions that have been damaged is well recognized (such as in recent myocardial infarcts). In any event, such a finding as in our case, should be an alerting sign for long term follow up, to detect any progressive renal impairment.

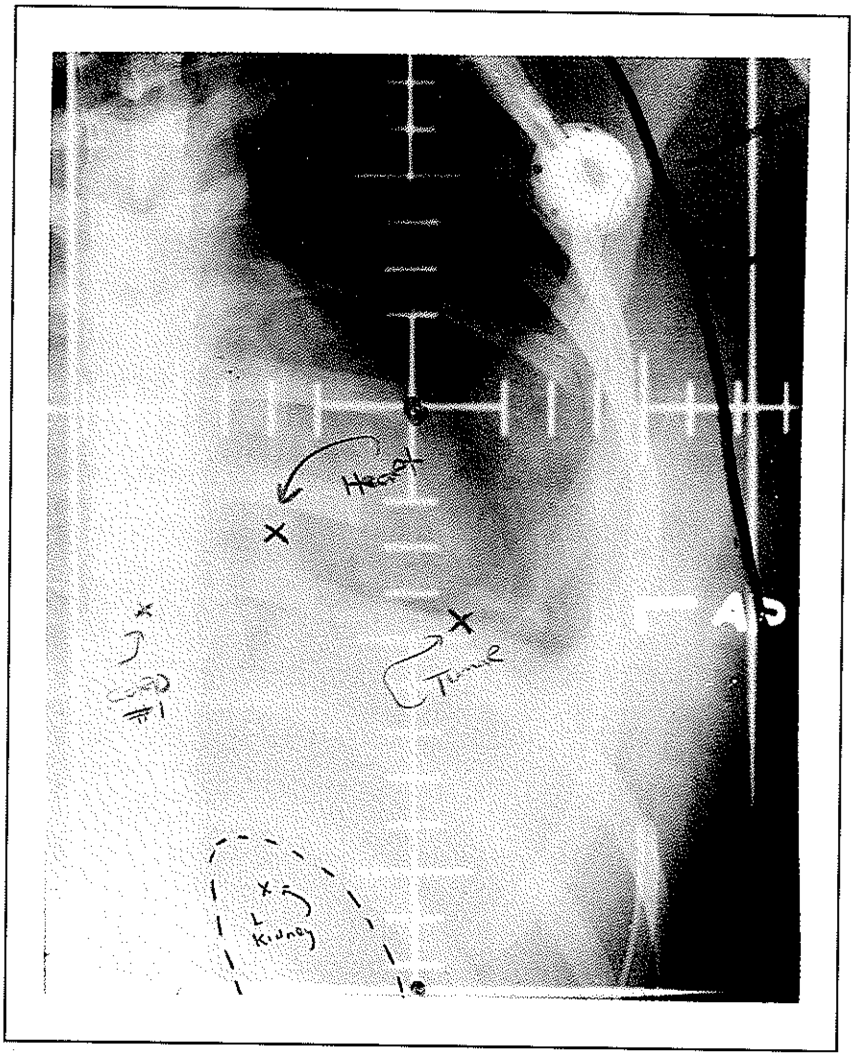

Figure 1. The planning radiograph, for radiation therapy, showed (in retrospect) that the upper pole of the left kidney had been included in the portal.

Figure 2. A TC-99m-MDP bone scan was obtained prior to the start of the radiation treatment. The left posterior oblique view (left above) revealed intense activity in a rib but no major renal uptake. A second bone scan (right) was carried out 5 months after completion of the course of radiation. Both a chest lesion and intense activity in the upper pole of the left kidney can be seen.

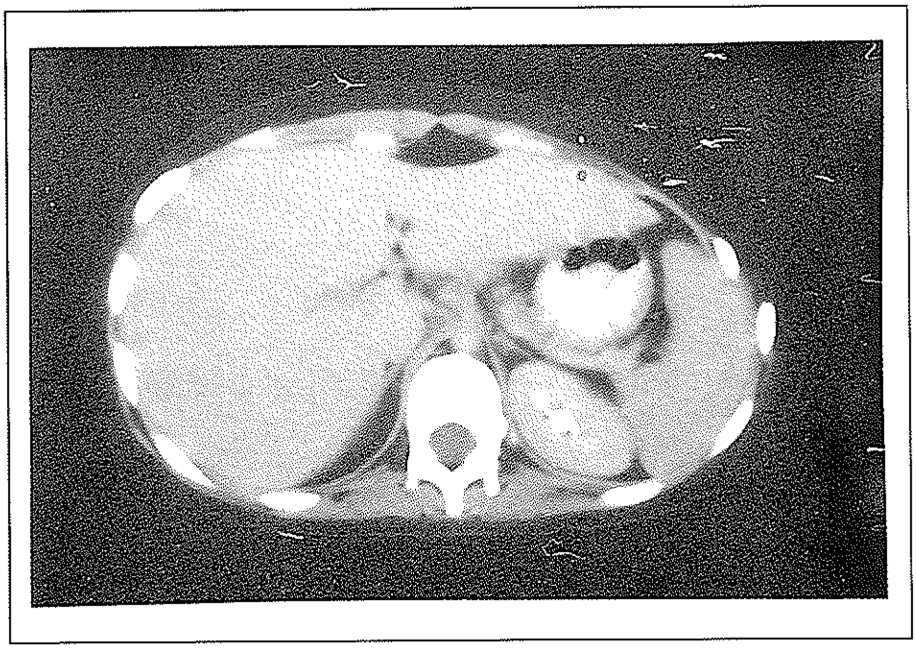

Figure 3. An abdominal CT examination was carried out to determine if there was tumor obstruction of urinary outflow. None was found. In this case, radiation therapy was responsible for abnormal parenchymal uptake of the bone imaging agent.

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