Incrustation and Uptake of Skeletal Imaging Agent in Transitional Cell Carcinoma

Mitsuru Taniguchi, Noboru Tatsuta, Hajime Yokota, Manabu Ouguchi, Koutarou Higashi, Tetsuro Okimura and Itaru Yamamoto

Department of Radiology, Kanazawa Medical University Hospital, Kahoku-gun, Japan

We present a case of transitional cell carcinoma of the bladder visualized by 99mTc-HMDP bone scintigraphy and suggest possible uptake mechanisms. Pelvic CT demonstrated a sessile bladder tumor with punctate and curvilinear calcifications on the surface areas (incrustation). Technetium-99m-HMDP bone scintigraphy demonstrated intense uptake corresponding to the site of the bladder tumor. Chemisorption of urinary 99mTc-HMDP, rather than of blood-born 99mTc-HMDP, may have occurred at the tumor surface.

Key Words: bladder tumor; transitional cell carcinoma; calcification; bone scintigraphy; technetium-99m-HMDP

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Although skeletal imaging agents are known to concentrate in various soft-tissue neoplasms (1), the uptake mechanism remains uncertain. Several theories have been proposed (2) such as: hyperperfusion (3), alteration of capillary permeability (4), binding by phosphate enzyme systems (5), metabolic process at the cellular level (6,7) and chemisorption at the crystal surface of calcification (8). Under normal serum calcium levels, calcification of soft-tissue neoplasm generally occurs within the tumor in association with tissue necrosis, and is classified as dystrophic calcification (9). In these tumors, chemisorption is thought to be operative for uptake of skeletal imaging agents, since most tissue calcium is in the form of hydroxyapatite, which has been proven to strongly chemisorb skeletal imaging agents (8,10,11).

In contrast, calcification of transitional cell carcinoma of the bladder commonly occurs on the surface of the tumor epithelium (incrustation) (12), as the result of precipitation of urinary calcium and not of serum calcium, secondary to infection and not to peripheral infarction (13).

We describe a patient with incrusted bladder tumor visualized by 99mTc-HMDP bone scintigraphy and discuss possible uptake mechanisms.

CASE REPORT

A 49-yr-old woman presented with painless, gross hematuria that was intermittent during the preceding 4 mo. Physical and blood examinations only disclosed mild anemia. Urinalysis revealed moderate occult blood, mild proteinuria and an alkaline pH (8.0), urine culture was sterile.

Pelvic CT demonstrated an irregular, sessile space-occupying lesion in the right anterior aspect of the bladder wall. Punctate and curvilinear calcifications were detected on the surface of the tumor epithelium (incrustation) (Fig. 1).

Bone scintigraphy was performed 3 hr following intravenous injection of 740 MBq 99mTc-HMDP for the evaluation of skeletal metastases. On the pelvic image, an intense uptake was detected close to the urine activity in the bladder cavity, corresponding to the site of the tumor documented by the CT (Fig. 2). Because of concern for bladder diverticulum, we added delayed scintigraphy. The patient was encouraged to drink fluids frequently to promote urine excretion and was imaged again after several times of micturition. The 8-hr delayed image of the pelvis revealed retention of the abnormal uptake, while the urine activity in the bladder cavity was no longer visible, excluding diverticulum (Fig. 3).

Subsequently, transurethral resection of the bladder tumor was performed; retrograde cystogram revealed no diverticulum. The ultimate histopathological diagnosis was Grade 3 papillary transitional cell carcinoma.

DISCUSSION

Calcification in uroepithelial tumors of the bladder is a rare radiographic finding (12,13). In transitional cell carcinoma of the bladder the most common location of calcification is on the surface of the tumor epithelium (incrustation) (12,13). The incrustation is thought to reflect a local pH interaction of the tumor epithelium and the urinary calcium, since calcium precipitation is favored by an alkaline urinary pH (13,14).

Miller and Pfister (13) reported that all bladder tumors with the incrustation had an associated urinary pH of seven or greater and normal serum calcium, both of which are represented in our case.

In reference to transitional cell carcinoma, a case of the renal pelvis visualized by 99mTc-MDP image was reported by Moreno et al. (15), and a case of a metastatic lymph node visualized by 85Sr-chrolide image was reported by Briggs and Wegener (16).

In Moreno et al.'s case (15), they found no calcification in the tumor even by the histopathological examination and suggested several uptake mechanisms other than chemisorption, such as possible selective binding of 99mTc-MDP to tissue receptors or hypervascularity, which might have occurred in our patient. Although the tumor revealed far more intense uptake than the
lumbar vertebrae in Moreno et al.’s patient, the tumor was less than or equal to the lumbar vertebrae. Such strong uptake as seen in our patient is most likely related to chemisorption to calcification (17).

In Briggs and Wegener’s patient (16), they found calcification (osseous metaplasia) in the metastatic lymph node, which was a rare occurrence and probably induced by uroepithelium. They concluded that chemisorption was responsible for uptake of 85Sr. While calcification in osseous metaplasia is derived from serum calcium, incrustation is the result of precipitation of urinary calcium as mentioned above. Thus, uptake by incrustation may have resulted from chemisorption of urinary 99mTc-HMDP excreted through the kidney (18) rather than of blood-born 99mTc-HMDP. To distinguish the mechanism of uptake as chemisorption of urinary 99mTc-HMDP versus chemisorption of blood-born 99mTc-HMDP, further studies would be needed such as a dynamic study of bladder activity (if the tumor was visualized when the bladder had little urine in it, one would favor the blood-born mechanism), or retrograde injection of 99mTc-HMDP into the bladder.

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REFERENCES